Foreword

Thank you for choosing the Delta DMV-C series area scan camera. This manual provides users with instructions for using the DMV-C series area scan cameras, including hardware model numbers and specifications. It will also explain the components required and the process for installing the camera hardware, and provide the user with recommended network card specifications and network architecture. In terms of software, the manual introduces DMV-SDK's installation and operations. DMV-Viewer provides users with fast imaging tests and configurations for various function parameters. It further describes the I/O input and output circuit diagrams and function parameter configuration methods. Lastly, it explains each function parameter provided for the camera in detail, including acquisition mode settings, auto exposure, gain adjustments, balance white adjustments, mirror settings, and LUT. Usage examples are provided for user reference.

It is recommended that users carefully read the user manual before using the software. The user should store the manual properly for reference by related personnel in the future.

Features of Delta DMV-C area scan cameras

The DMV-C industrial cameras provide users with a wide range of resolutions and gray scale or color cameras. The user can choose between global shutters or rolling shutters for dynamic capturing or static capturing. The 400,000 pixel industrial camera provides up to 290 fps and can be configured for high-speed shooting.

The DMV-C uses GigE Vision standards interface and an Ethernet connection for image transfers. The optimal network speed is 1Gbps. The DMV-C complies with the standard functions defined by GenICam. The user can control the various functions provided by the camera through the XML file, such as changing the acquisition mode, adjusting the frame rate, exposure value, and gain value. At the same time, the DMV-C also provides a 6-pin I/O port, which contains an input signal and two output signals, allowing for flexible industrial camera applications.

DMV-C Camera User Manual v1.0

Table of Contents

Table of Contents

Chapter 4 Function and Parameter Settings

Appendix

Version revision history

Version	Content of revisions	Date of issue
Version 1	Publication of Version 1	2023/04/27

Chapter 1

Product Specifications

This chapter will explain the Delta DMV-C industrial camera specifications. The user can find the basic information of the DMV-C camera and the warnings.

1.1 All Model Numbers and Specifications of the DMV-C Series

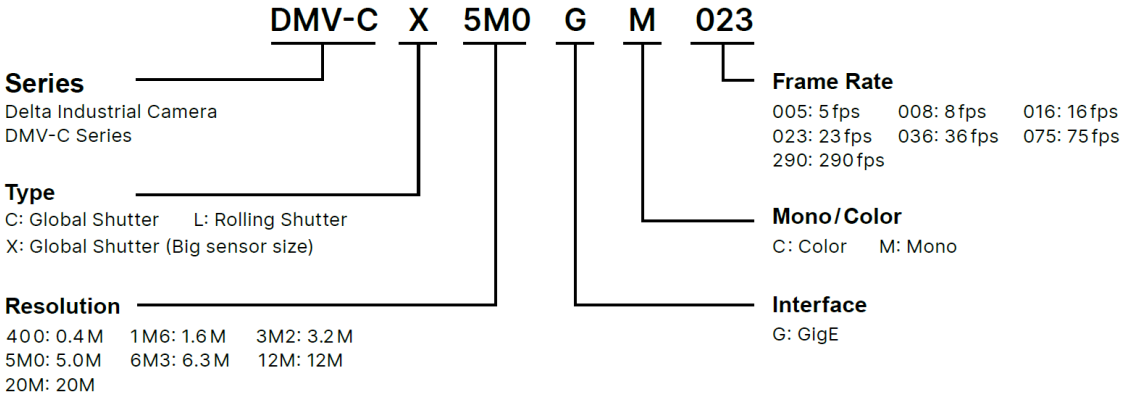
The current models and specifications of the DMV-C industrial cameras are shown in the table below.

1.1.1 Model number and specifications

Model number	Sensor model number	Resolution (W × H)	Optical dimensions (inch)	Shutter type	Exposure time range	Pixel dimensions (um)	Frames per second	Color	Pixel format	GPIO
DMV-CC400GM290	IMX287	720 × 540	1 / 2.9	Global shutter	20 us~1 s	6.9	290	Gray scale	Mono (12,10,8) Bayer (12,10,8)	1 PC Optics isolated input 2 PC Optics isolated input
DMV-CC400GC290								Color		
DMV-CC1M6GM075	IMX273	1,440×1,080				3.45	75	Gray scale		
DMV-CC1M6GC075								Color		
DMV-CC3M2GM036	IMX265	2,048×1,536	1 / 1.8				36	Gray scale		
DMV-CC3M2GC036								Color		
DMV-CX5M0GM023	IMX264	2,448×2,048	2 / 3				23	Gray scale		
DMV-CX5M0GC023								Color		
DMV-CL5M0GM023	IMX335	2,592×1,944	1 / 2.8	Rolling shutter		2		Gray scale		
DMV-CL5M0GC023								Color		
DMV-CL6M3GM016	IMX178	3,072×2,048	1 / 1.8			2.4	16	Gray scale	Mono (10,8) Bayer(10,8)	
DMV-CL6M3GC016								Color		
DMV-CL12MGM008	IMX226	4,000×3,000	1 / 1.7			1.85	8	Gray scale	Mono (12,10,8) Bayer (12,10,8)	
DMV-CL12MGC008								Color		
DMV-CL20MGM005	IMX183	5,472×3,648	1			2.4	5	Gray scale		
DMV-CL20MGC005								Color		

1.1.2 Model numbering convention

The naming conventions for the Delta DMV-C industrial camera models are shown in the figure below. The user can check the general specifications of the DMV-C through the model number.



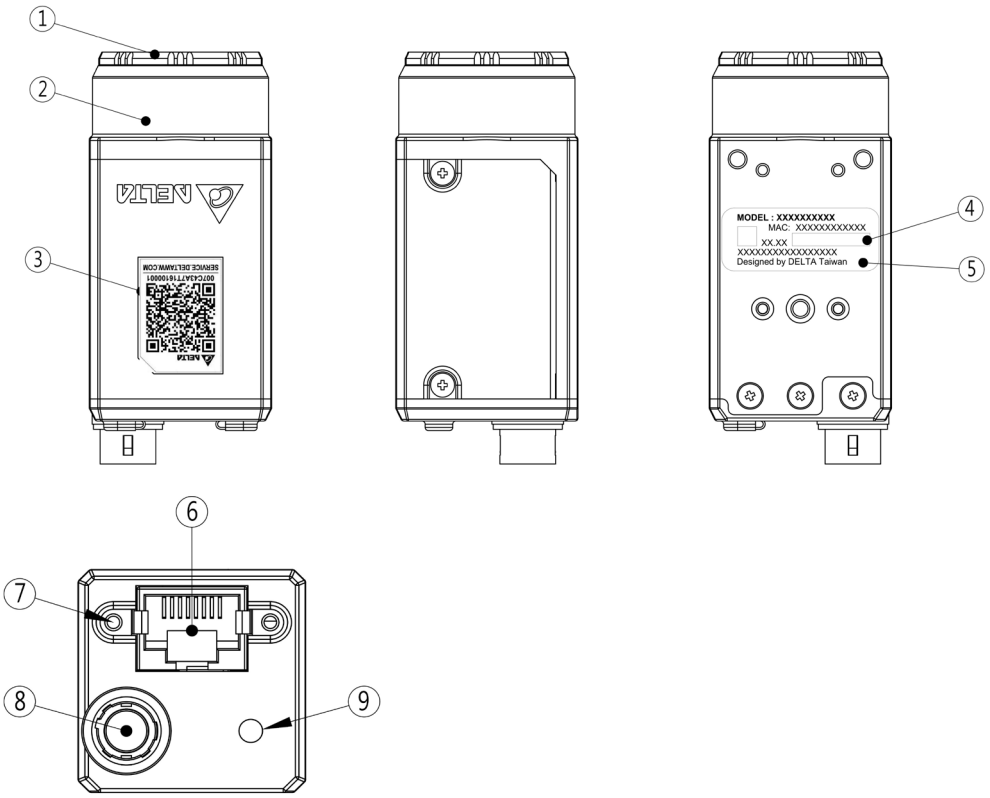
1.2 General Specifications

Interface	10/100/1000 Mbps Ethernet, GigE Vision 2.0 compliant
Triggering mode	Software, External I/O input
Capture mode	Single frame, Multiple frames, Continuous
Power consumption	<5W
Power supply method	Choose DC 12 to 24V or PoE (IEEE 802.3af)
Exterior dimensions	45 × 29 × 29 mm
Weight	92g
Lens mount	C-Mount connector
Temperature	Storage: - 20°C to 85°C. Operation: 0 ~ 45°C
Certification standards	CE, KC, RoHS, IP30
Driver	DMV-SDK or third-party GigE Vision 2.0 software
Driver compatible operating systems	Windows 7 ~ 10 / Linux (Ubuntu 16.04 or above)

1.3 Mechanical Specifications

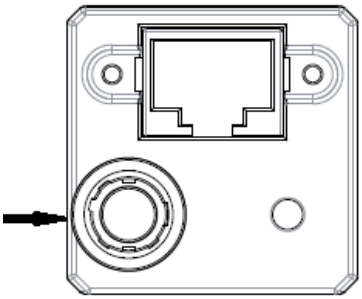
The Delta DMV-C industrial cameras are equipped with an RJ45 port, RJ45 screw hole, 6-pin I/O port, and mount adapter. The DMV-C complies with IP30 protection standards, which means each DMV-C industrial camera is delivered with a lens protection cover to protect the interior of the camera.

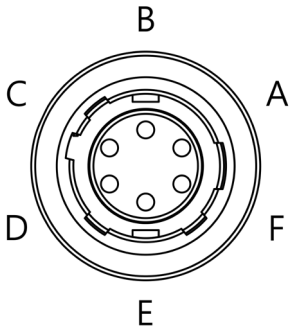
1.3.1 Camera part names



Serial No.	Name
(1)	Lens cover
(2)	C-Mount joint
(3)	Delta service QR code
(4)	MAC ID
(5)	Product label
(6)	RJ45 connector
(7)	RJ45 thread hole (M2x0.4 ↧ 4)
(8)	I/O connector
(9)	Indicator

1.3.2 I/O port definitions

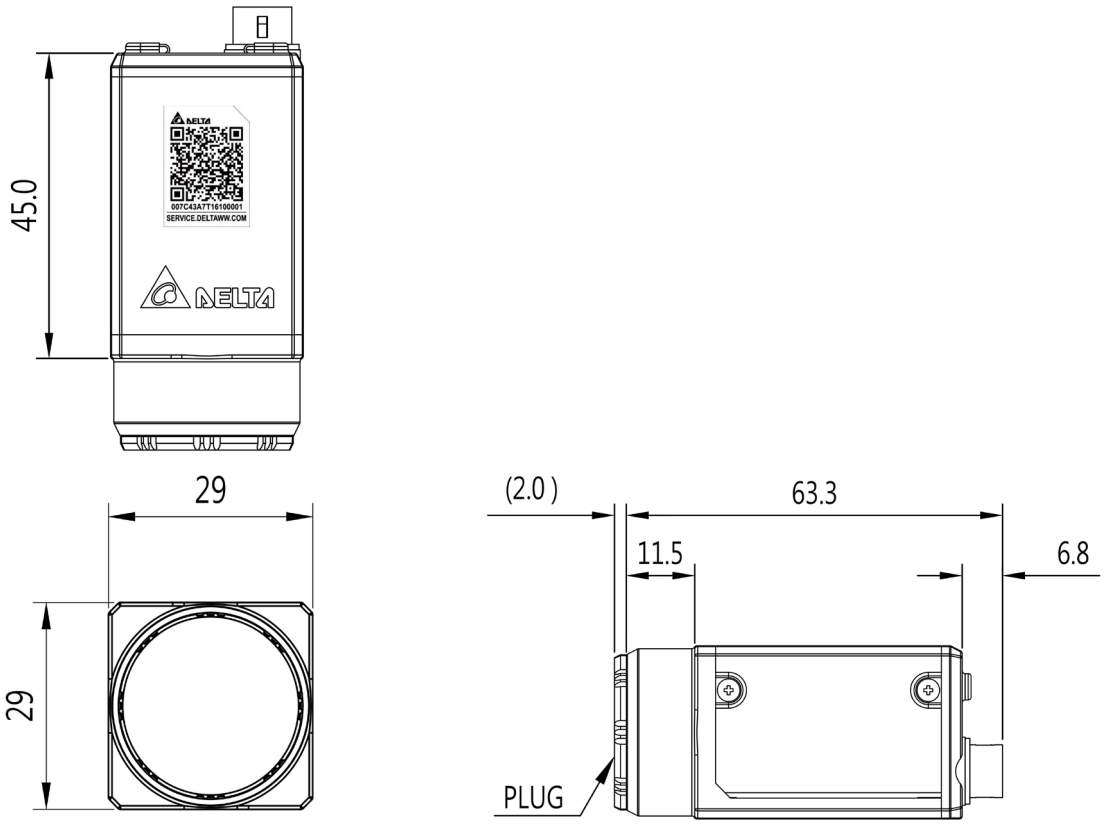




I/O DETAIL

Serial No.	Name	Wire color
(A)	Power input	Brown
(B)	Line1 Input	Red and white
(C)	Line3 Output	White
(D)	Line2 Output	Black
(E)	I/O Com	Red and black
(F)	Ground	Blue

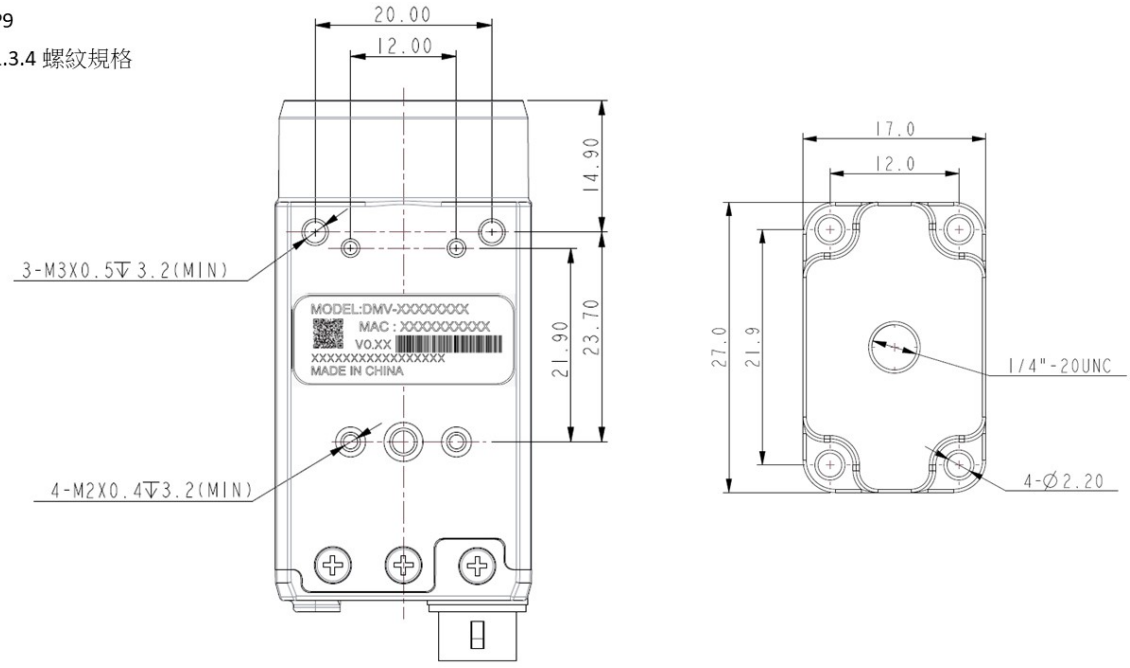
1.3.3 Outer dimensions of the camera



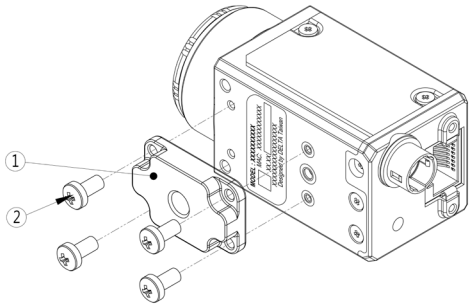
1.3.4 Thread specifications

P9

1.3.4 螺紋規格

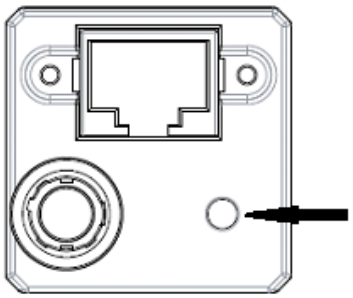


1.3.5 Mount adapter installation



Serial No.	Name
(1)	Mount Adapter
(2)	Screws M2 x 0.4 ↧ 3

1.3.6 LED indicators



Indicator/status	Blinking	Steady
Red light	Error	Fatal error
Orange light	Initializing	Idle (waiting for connection)
Green LED	Capturing	Ready (connected)

1.4 Notice

To ensure the normal operation of the DMV-C industrial camera and personnel safety, please pay attention to the following matters when operating the DMV-C camera.

1. Please keep away from high voltage and powered equipment to ensure safe operations and maintenance.
2. To prevent damage due to an incorrect voltage input level, please check to ensure that all signal connections, such as input voltage and polarity, are correct before powering on any component.
3. Please ensure that device power is turned off before inspecting the power source or connecting the wires. To avoid electrical shock, never touch the terminals or connect the wires while system power is turned on.
4. Please do not attempt to disassemble or modify the internal components of the controller.
5. Keep away from scrap metal, which could interfere with operation or even cause damage to the components.
6. Gently wipe dust off of the lens using a lens cloth to remove attached dirt. Using excessive force or inappropriate materials may scratch the lens.
7. Only use a blower cleaner to remove dust from the camera sensor and lens. To avoid getting moisture on the components, never blow on any of the components with your mouth.
8. Do not use the device in places with combustible gases.
9. Please clean the product with a dry cloth. Do not use cleaning solutions containing acidic or alkaline chemicals.
10. When using the camera, the recommended ambient temperature is between 0°C to 45°C to ensure stable camera operations.

Chapter 2

Hardware and Software Installation Instructions

This chapter describes the Delta DMV-C area scan camera's hardware, DMV-SDK software installation, and the network IP configuration mode. The user can follow the chapter to understand the components required when operating the camera, and complete the camera installation according to the instructions.

2.1 Components Required for Hardware Installation

Before installing the DMV-C area scan camera, please ensure the following components have been prepared.

1. Ethernet cable. The optimal network speed for the DMV-C camera is 1 Gbps. Therefore, please choose CAT-5e or above Ethernet cables to ensure that the network speed meets the camera's operating requirements. Part number of Delta's Ethernet cable is DMV-CAF5MGE.

2. 6-pin GPIO cable. The DMV-C camera is equipped with a set of power and I/O ports. When a DC power supply or I/O functions are required through these ports, the user should prepare a 6-pin GPIO cable. Part number of Delta's GPIO cable is DMV-CAF5MT.
   When installing the 6-pin GPIO cable, please align the pins first then insert in to avoid damaging the pins.

3. 1K pull-up resistor. When using the I/O functions, if both input and output signals are used and wired according to NPN type, a 1K pull-up resistor needs to be installed. Please refer to Chapter 3 I/O details.

4. C-mount lens. All DMV-C series cameras use C-mount connectors. The user should select a corresponding C-mount lens according to usage requirements.

5. Gimbal mount. The DMV-C camera is shipped with a gimbal mount and 4 fastening screws. The user can mount the DMV-C camera after installing the gimbal.

6. Network card. The images captured by the DMV-C camera will be transmitted to the host through the Ethernet cable. Therefore, the host must be installed with a network card. Recommended network card specifications include support for 1GbE data transfer and jumbo frames).

7. Power supply device. The DMV-C camera support two types of power supply, which are DC power input and Power over Ethernet (PoE). The user can choose the most suitable power supply according to the usage setting. For details, please refer to Chapter 2.2.

2.2 Power Supply

The Delta DMV-C area scan camera supports two types of power supply, which are DC power input and Power over Ethernet (PoE). The user can choose the most suitable power supply according to the usage requirements.

1. DC Power input

When using DC power input, a 6-pin GPIO cable is required. The power should be connected according to the I/O definitions. Please refer to the following figure for I/O definitions. The input power should be DC 12V to 24V.

Delta recommends using the 6-pin GPIO cable which part number is DMV-CAF5MT.

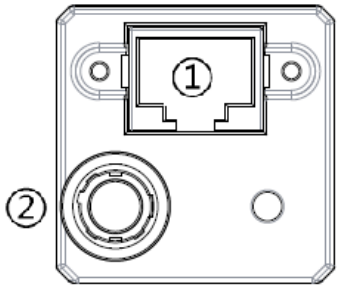
Please note that directly connecting a power supply with too high voltage will damage the camera. Voltage that is too low will cause operational errors with the camera.

2. Power over Ethernet (PoE)

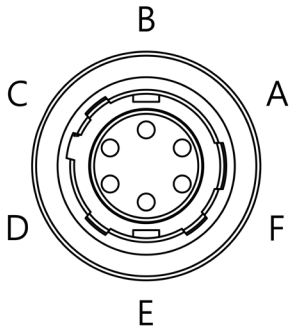
The DMV-C camera can also be powered through Ethernet. A network card with PoE can be installed in the power supply, or Power Sourcing Equipment (PSE) can be used, such as PoE injector, to supply power.

The power consumption level of the DMV-C camera is PoE 802.3af Class 2. When using PoE Ethernet to supply power, power supply equipment that complies with PoE 802.3af should be selected to ensure the correct input wattage. Please select Cat-5e or above Ethernet cables.

Please note that using a PSE that does not comply with IEEE 802.3af standards or passive POE injector could cause damage to the camera due to the incorrect power input.



Serial No.	Name
(1)	RJ45 connector
(2)	I/O connector



I/O DETAIL

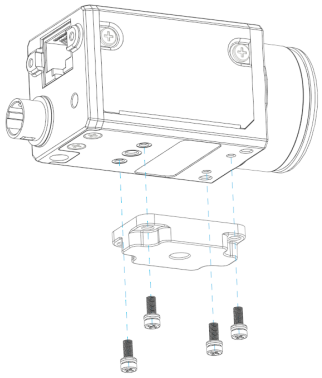
Serial No.	Name	Wire color
(A)	Power input	Brown
(B)	Line1 Input	Red and white
(C)	Line3 Output	White
(D)	Line2 Output	Black
(E)	I/O Com	Red and black
(F)	Ground	Blue

2.3 Hardware Installation Steps

This chapter will explain the hardware installation steps of the Delta DMV-C Area Scan Camera. The user may begin the DMV-C hardware installation after preparing the required components stated in Chapter 2.1.

1. Establish the machine vision system. The user should select a DMV-C camera with a specific resolution based on the field of view defined by the scenario. The user shall also define the height of the camera and focal distance of the lens.

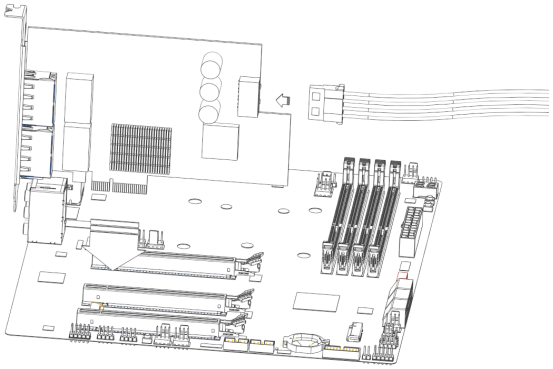
2. Attach the camera to the mount adapter. Each DMV-C camera comes with a mount adapter and four M2 tightening screws.



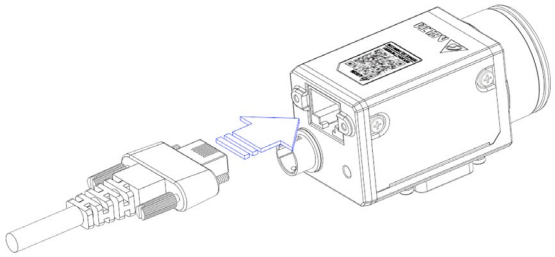
3. Install the lens. Point the DMV-C camera downwards and remove the lens cover. Affix the C-mount lens.

4. Mount the camera on the machine. Mount the DMV-C camera with lens on the machine through the mount adapter.

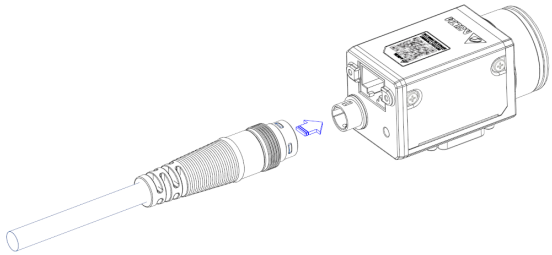
5. Install the network card on the computer. Please follow the installation instructions in the manual provided by the network card manufacturer and make sure to connect the IDE or SATA power connector of the network card to the power supply of the computer. Enter the device manager to confirm the card installation. If there is an exclamation mark, it means the installation is not complete. Please refer to the network card manual to complete installation.



6. Connect the Ethernet cable. Connect the ethernet cable to the DMV-C camera and the network port of the computer. If you are using PoE ethernet to supply power, please follow the correct steps to connect the power Sourcing Equipment (PSE) and DMV-C camera.



7. Connect the 6-pin GPIO cable. DC power supply or I/O functions should be wired according to the DMV-C I/O definition to ensure normal functioning. If DC power supply or I/O functions are not used, this step can be skipped.

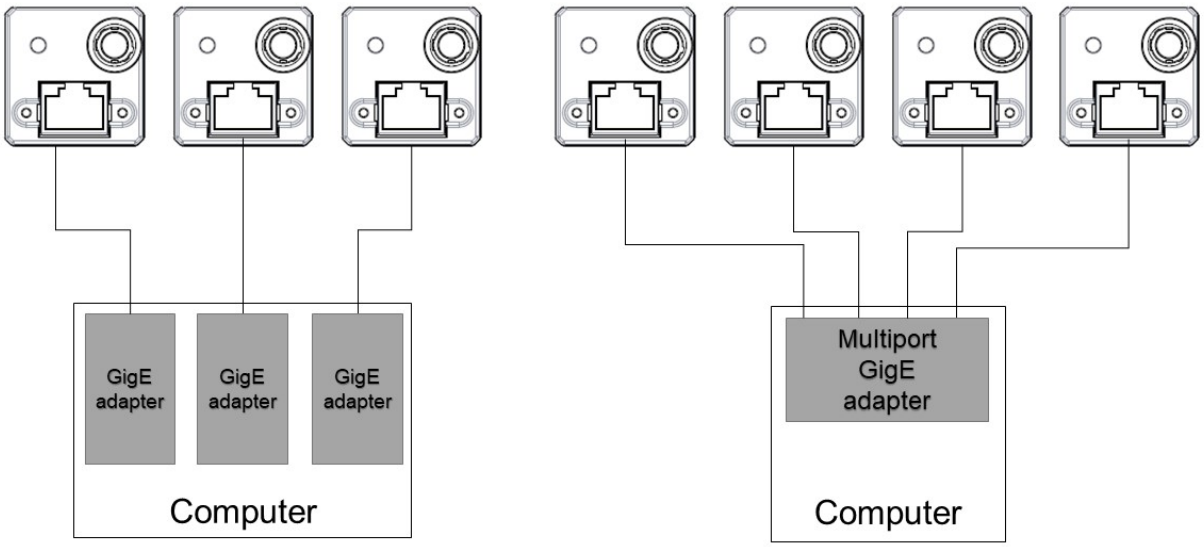


8. Turn on the power. Once the above steps are completed and confirmed to be correct, power can be supplied and the DMV-C camera can be turned on.

9. The DMV-C camera will automatically enter the boot process when turned on. The user can use the LED indicators to check the current status of the DMV-C. When booting, the LED indicator of the DMV-C will flash orange until the boot process is complete. Once ready, the LED indicator will remain orange light. This means the DMV-C has completed the boot process and is waiting for connection. The user can then use the software to connect to the DMV-C.

2.4 Network Architecture

The optimal network speed of the DMV-C camera is 1 Gbps, that is to say, when multiple DMV-C cameras are connected, each camera should be equipped with a network speed of 1 Gbps, and the network architecture should be a peer-to-peer network. The host should be connected to the DMV-C camera through multiple network cards or a multi-port network card, as shown in the figure below.



2.5 Network Card Specifications and Model Number

To ensure a good network environment for the DMV-C camera, Delta recommends the use of network cards that support 1 Gbps network speeds and jumbo frames.

The recommended network card models are as follows:

- Intel i210 series
- Intel i350 series

2.6 Network Setup

This chapter will explain the IP configuration mode for the DMV-C camera and the behavioral process after connection.

2.6.1 IP setup mode

The three IP configuration modes for connecting the DMV-C camera are as follows:

1. Persistent IP address: The user can enable persistent IP mode and set the persistent IP and subnet mask by configuring the function parameters. Please refer to Chapter 4.8 for the configuration method.
2. DHCP (Dynamic Host Configuration Protocol): When using DHCP and the camera detects a DHCP server, the DHCP server will provide a set of IP and subnet mask to the camera.
3. LLA (Link Local Address): When using link local address, the camera will automatically generate an IP. The range of the IP is from 169.254.0.1 to 169.254.255.254.

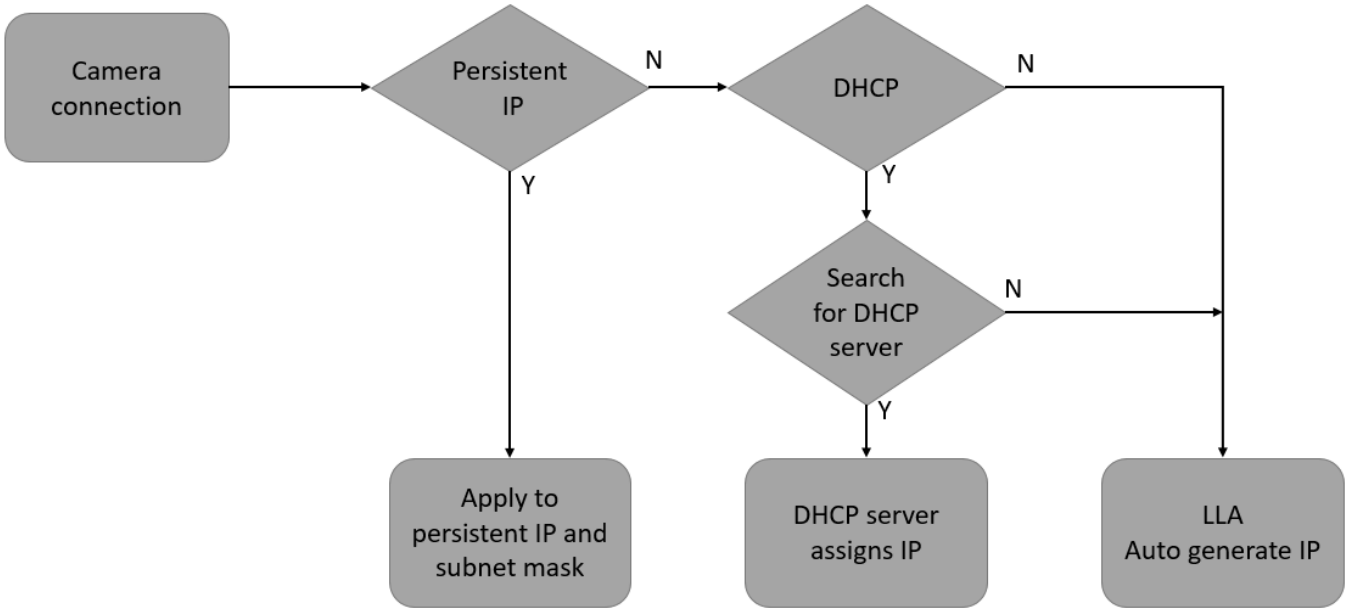
In the default IP mode of the DMV-C camera, DHCP and LLA are enabled and persistent IP is disabled.

Please note that the DMV-C camera IP mode will be saved, and the same IP mode will be loaded when powered on again.

2.6.2 Camera connection process

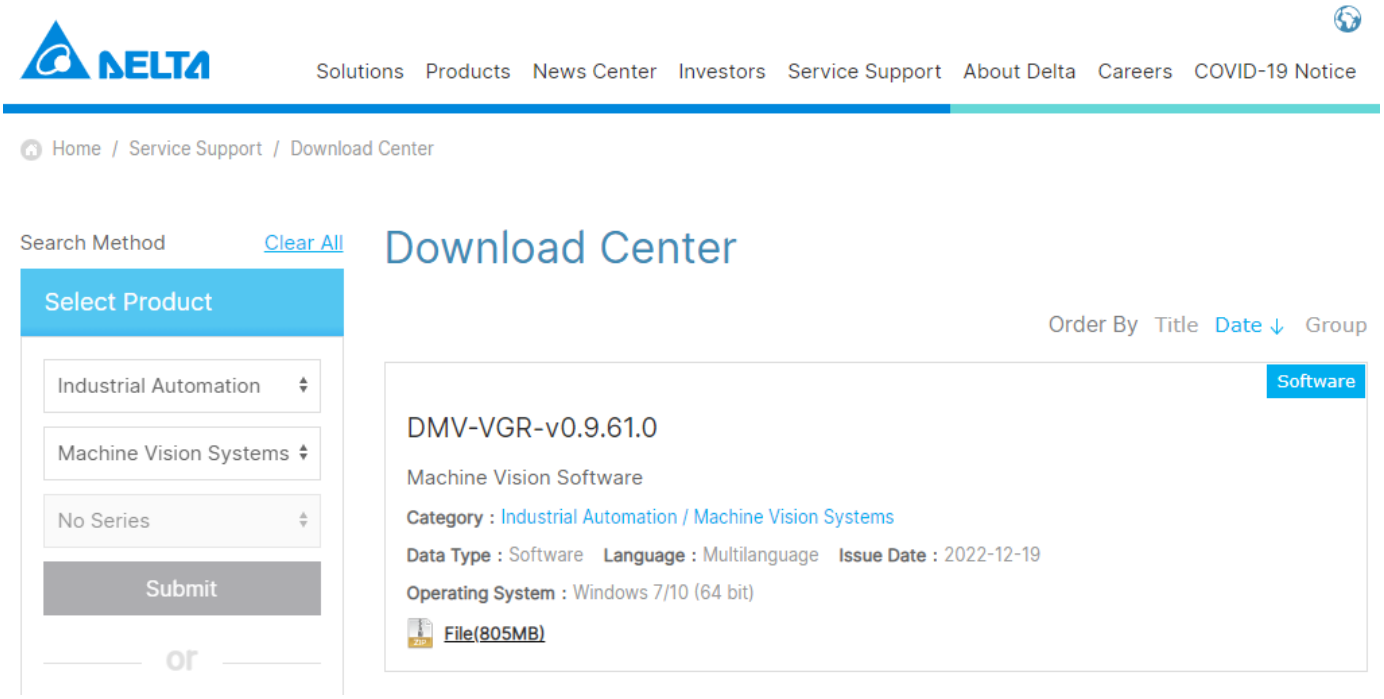
When the DMV-C camera is turned on, it will follow a fixed process to connect to the network:

1. The camera will first confirm whether persistent IP is enabled. If enabled, the camera will use the persistent IP and subnet mask set by the user.
2. If the camera is not using a persistent IP, it will then confirm whether DHCP is enabled. If enabled, the camera will start to detect a DHCP server. When the DHCP server is detected, the camera will obtain a set of IP from the server. If a DHCP server cannot be detected, the camera will automatically generate a set of IP through LLA mode.
   Note: When using a DHCP connection, the connection time will be longer because the camera needs to search for a DHCP server.
3. If the camera does not use a persistent IP and DHCP, the camera will automatically generate an IP using LLA mode.



2.7 DMV-SDK Installation

The user can go to the download center of the Delta website to download the DMV-SDK software. Search by product category: industrial automation and machine vision systems, and find DMV-SDK on this page. Click to start the download.

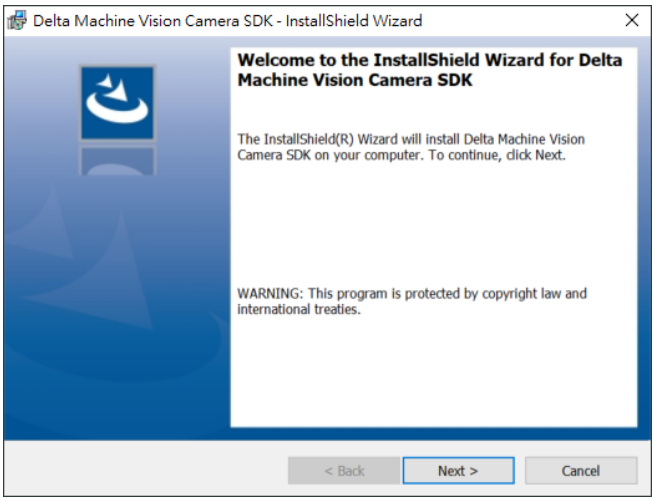


After the download is complete, the installation steps are as follows:

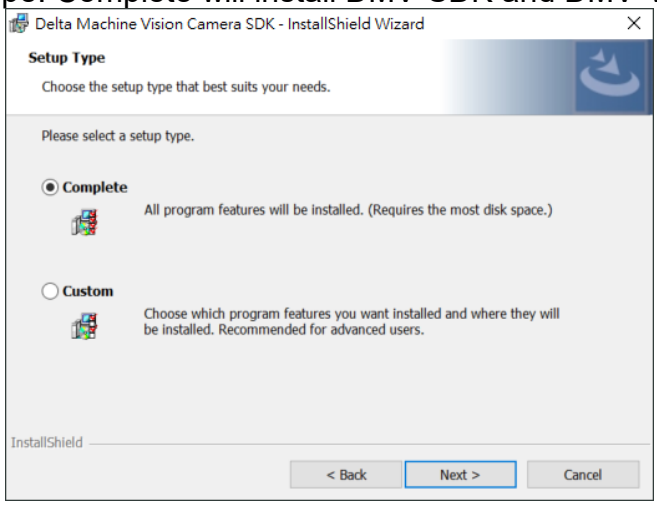
1. Click the .exe file to begin installation.

2. The software will start preparing for installation.

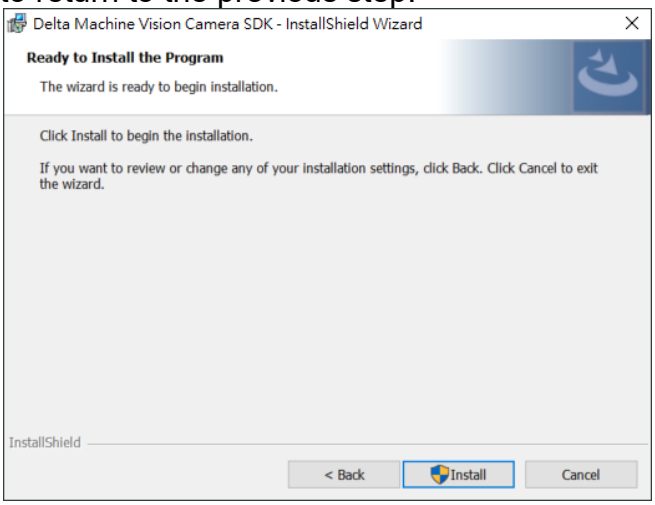
3. Click Next to continue the installation process.



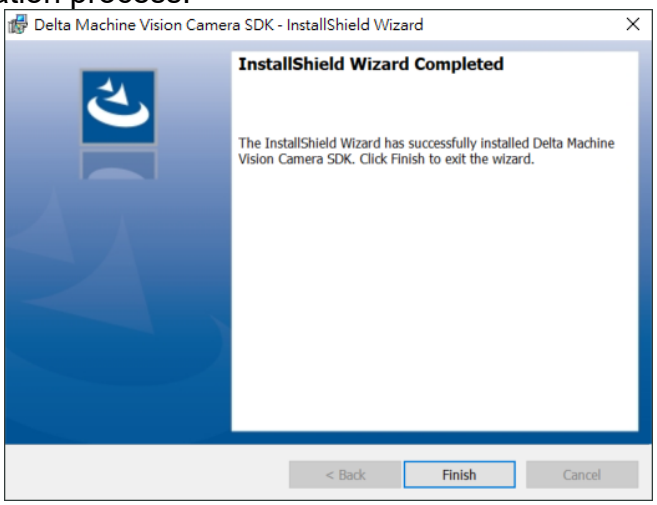
4. Select the installation type. Complete will install DMV-SDK and DMV-Viewer completely.



5. Click Install to start the software installation. If the users need to re-select the installation type, the user can click Back to return to the previous step.



6. After the installation is successful, the installation completion message will be displayed. Click Finish to end the installation process.

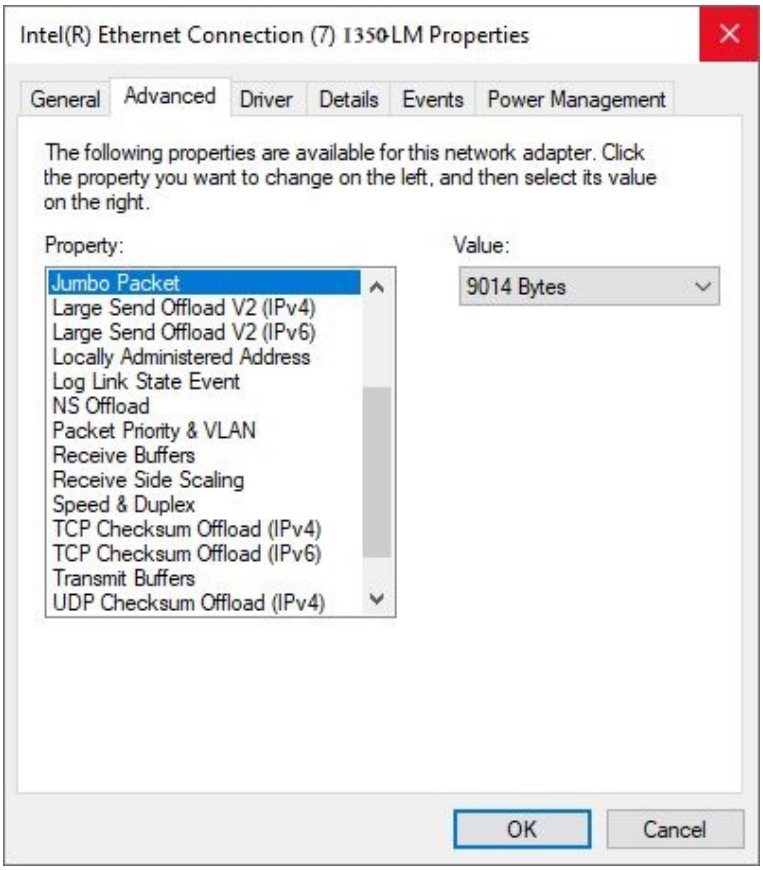


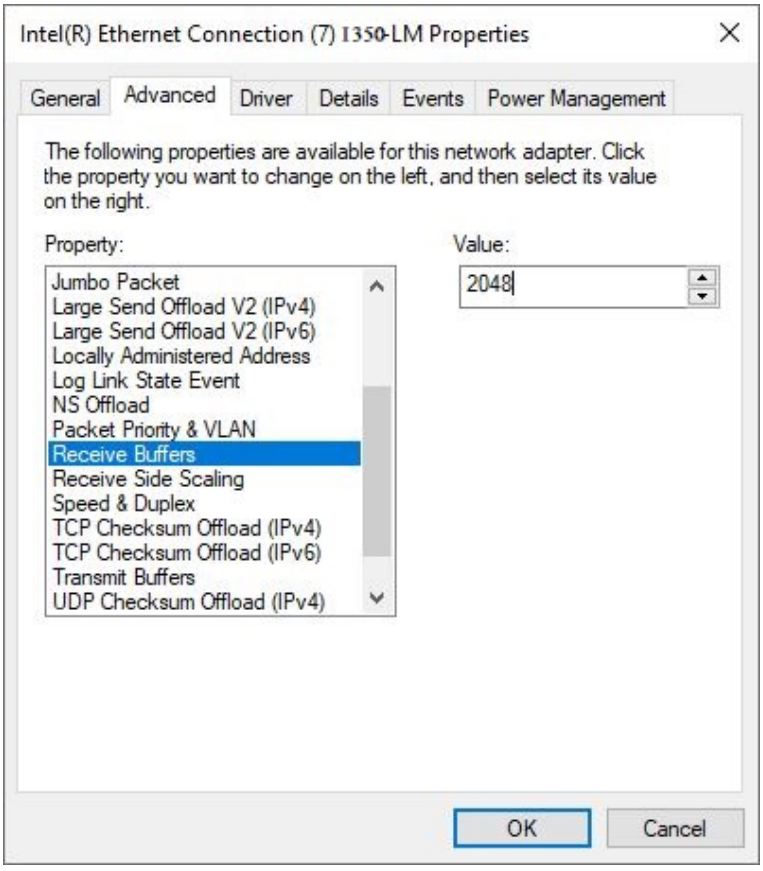
7. DMV-SDK will be automatically installed in the following path.
   C:\Program Files\Delta Industrial Automation\DIAVision\DMVC

8. Path of DMV-Viewer: C:\Program Files\Delta Industrial Automation\DIAVision\DMVC\Applications\bin

9. Before running the camera, you need to enable the Jumbo packet(Jumbo frame) function and receive buffers in the network settings:

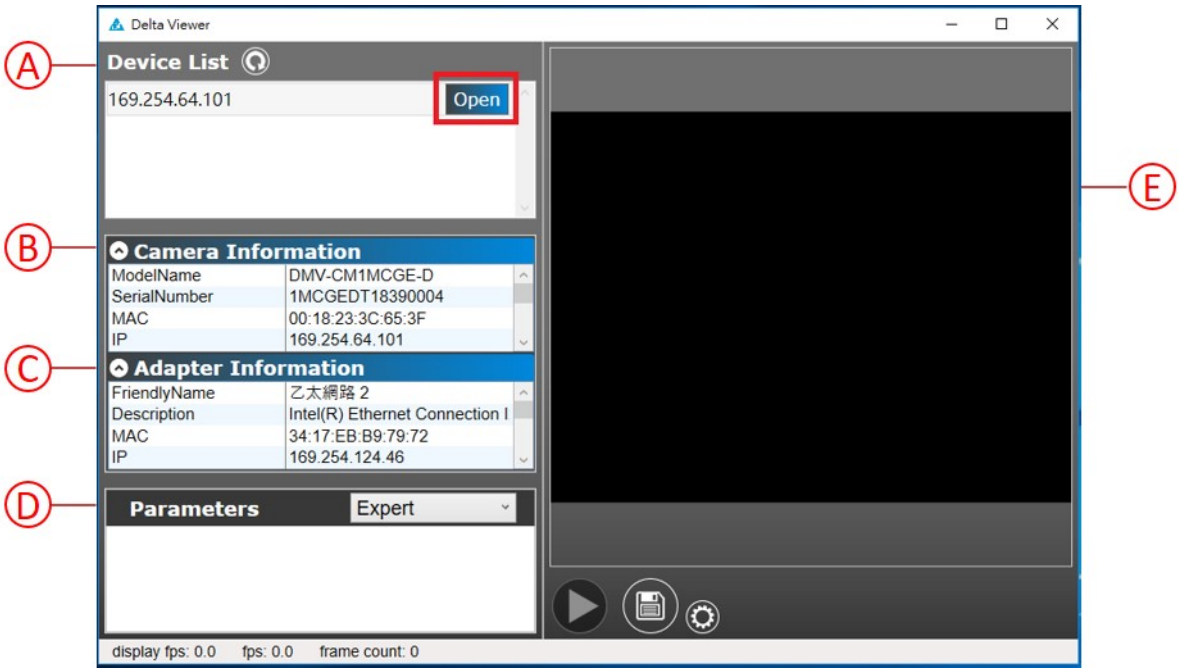
A. Start → Windows System → Control Panel → Network and Internet → Network and Sharing Center → Change adapter settings
B. Right click on the network being used → Properties
C. Click Settings → Advanced → Select Jumbo Packet → 9014 bytes
D. Select Receive Buffers→2048


Intel(R) Ethernet Connection (7) I350-LM Properties
General
Advanced
Driver
Details
Events
Power Management
The following properties are available for this network adapter. Click the property you want to change on the left, and then select its value on the right.
Property:
Value:
Jumbo Packet
Large Send Offload V2 (IPv4)
Large Send Offload V2 (IPv6)
Locally Administered Address
Log Link State Event
NS Offload
Packet Priority & VLAN
Receive Buffers
Receive Side Scaling
Speed & Duplex
TCP Checksum Offload (IPv4)
TCP Checksum Offload (IPv6)
Transmit Buffers
UDP Checksum Offload (IPv4)
9014 Bytes
OK
Cancel


Intel(R) Ethernet Connection (7) I350-LM Properties
General
Advanced
Driver
Details
Events
Power Management
The following properties are available for this network adapter. Click the property you want to change on the left, and then select its value on the right.
Property:
Value:
Jumbo Packet
Large Send Offload V2 (IPv4)
Large Send Offload V2 (IPv6)
Locally Administered Address
Log Link State Event
NS Offload
Packet Priority & VLAN
Receive Buffers
Receive Side Scaling
Speed & Duplex
TCP Checksum Offload (IPv4)
TCP Checksum Offload (IPv6)
Transmit Buffers
UDP Checksum Offload (IPv4)
2048
OK
Cancel

2.8 DMV-Viewer Interface

This chapter will explain the DMV-Viewer interface.



A. Device list

Displays all the cameras currently connected to the computer network. Select one of the cameras to load its parameters. Click  to refresh the camera list.

B. Camera information

The camera information shows the camera's model number, serial number, MAC, IP address, subnet mask, default gateway, manufacturer name, system version, GigE Vision version, and user-defined name.

C. Adapter information

The adapter information shows the user network's name, description, MAC, IP address, subnet mask, default gateway, DHCP server, DNS, transfer speed, download speed, and maximum transfer packet size.

D. Parameter list

Displays all functions provided by the camera and provides access to parameters for managing the camera.

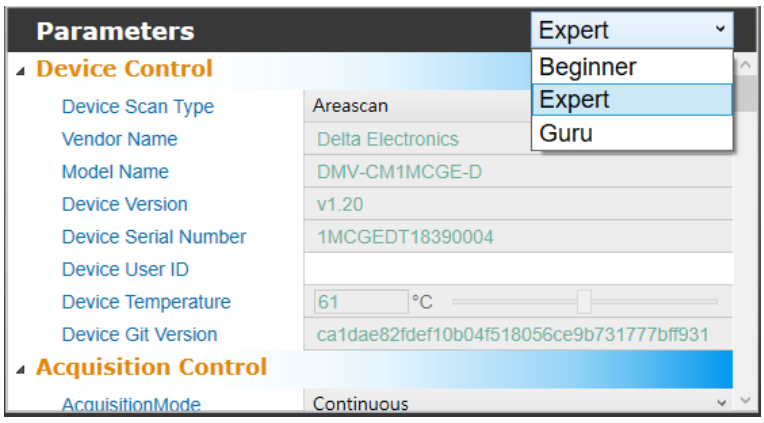
The camera functions are divided into:

- Device Control
- Acquisition Control
- Analog Control
- Image Format Control
- User Set Control
- Transport Layer Control
- Digital I/O Control
- Auto Functions

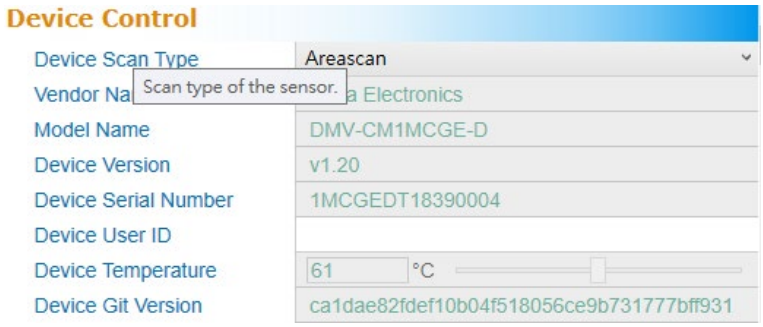
According to the different definitions of function parameters, some parameters are read-only and some can be written. Please refer to Chapter 4 for the function parameter descriptions. From the shortcuts, the user can decide the visibility of parameters.

- Beginner
- Expert
- Guru

By default, the DMV-Viewer display level is Expert.



A description of the parameter will be shown when hovering over the parameter text with the mouse.

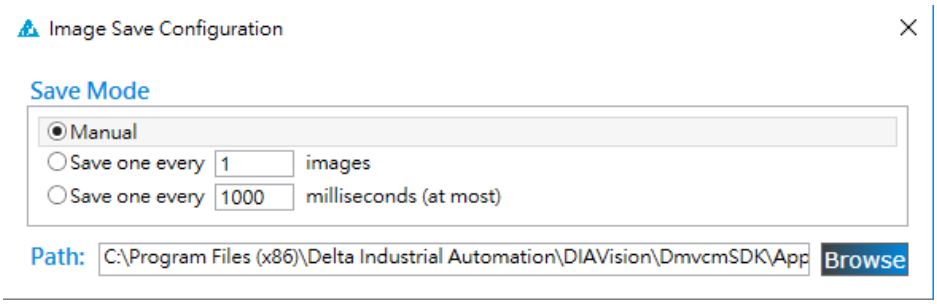


E. Graphic display window

The image display window shows the image being captured and the information related to the image settings.

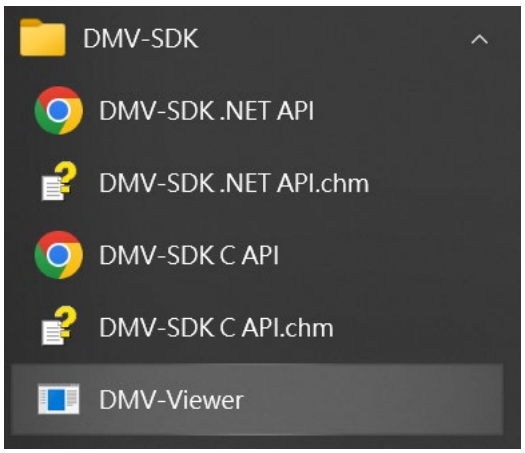
Click  to start capturing images with the camera.

Clicking  will save the current image in the current save path.



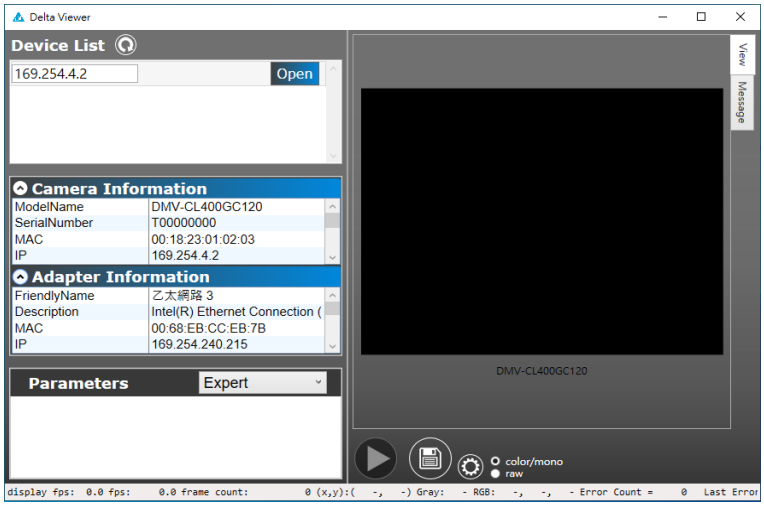
2.9 DMV-Viewer Camera Connection

1. Connect the camera to a computer
2. Opening DMV-Viewer: Start → DMV camera SDK → DMV-Viewer

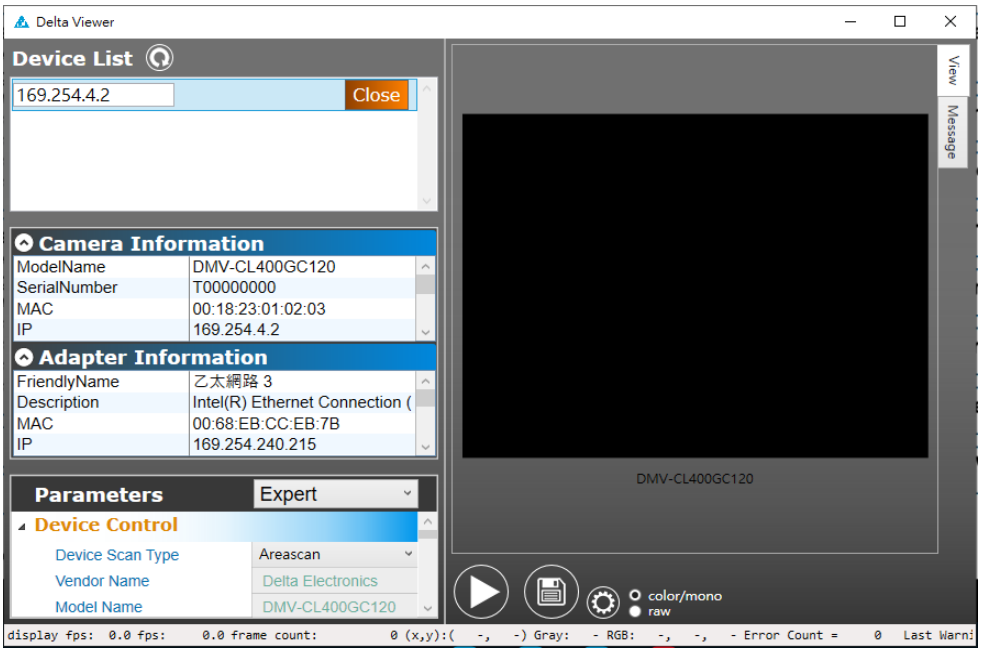


3. Connect the camera

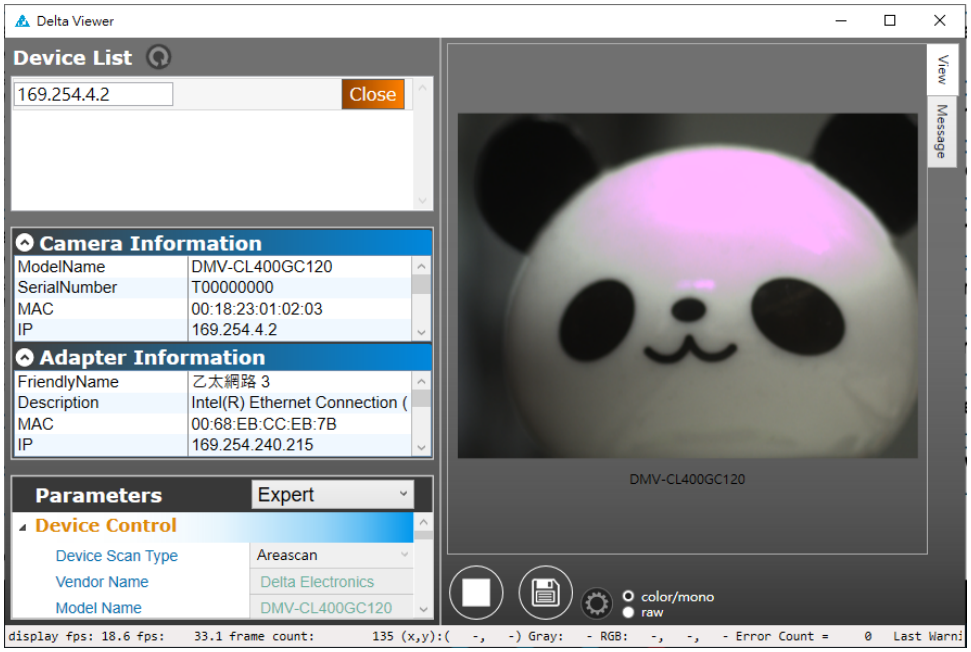
   The camera will appear in Device List (requires manual refresh). Click on Open to connect the camera.



When the camera is connected, the Open will change to Close.



When the camera captures an image, the  will change to  .



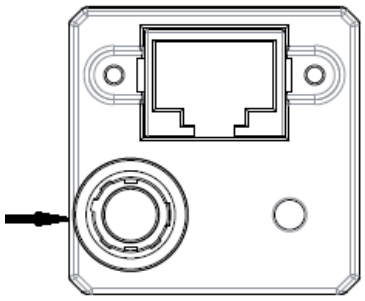
Chapter 3

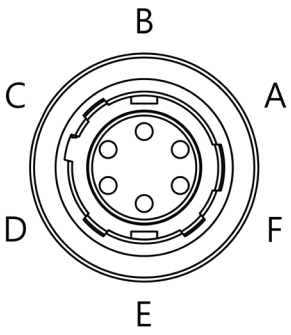
I/O Input and Output Configuration

This chapter will provide the I/O connector definition table, the circuit diagrams for various input and output applications, and further explain the I/O functions and configuration methods for the DMV-C camera.

3.1 I/O Contact Definitions

The DMV-C camera is equipped with a 6-pin GPIO port. It allows for DC power input and I/O input and output functions. The definition table of the different pins of the port is as follows.





I/O DETAIL

Serial No.	Name	Wire color
(A)	Power input	Brown
(B)	Line 1 Input	Red and white
(C)	Line 3 input	White
(D)	Line 2 input	Black
(E)	I/O Com	Red and black
(F)	Grounding	Blue

3.2 I/O Circuit Diagram

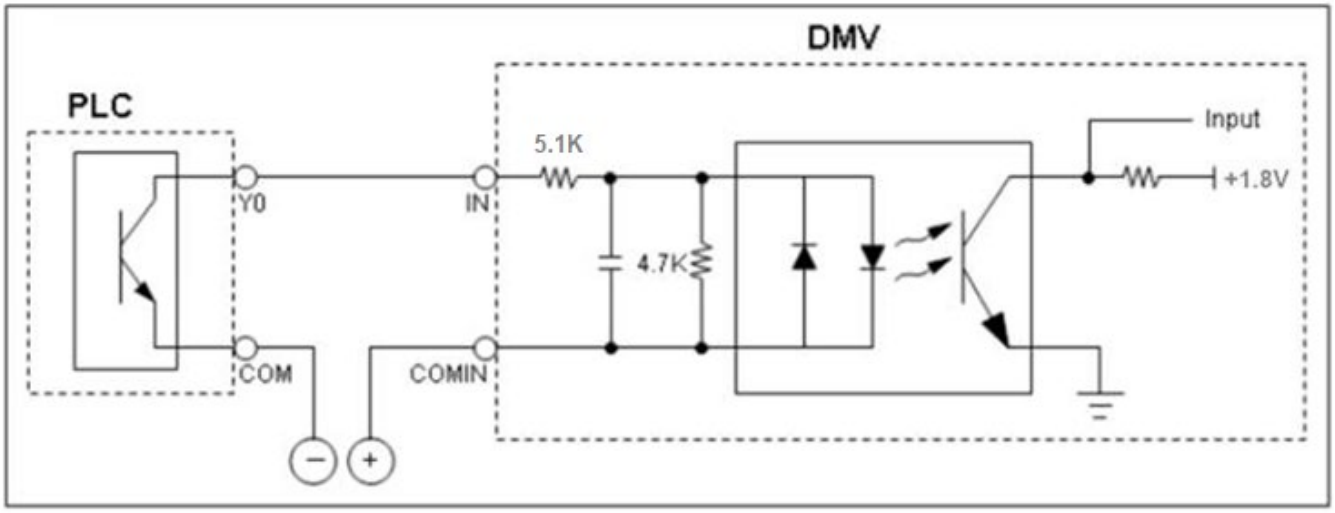
The DMV-C camera provides an OptoCoupled input and two OptoCoupled outputs. The input and outputs can be wired differently according to different uses. In total, there are 5 combinations of whether the user is using only input, only output, or both input and output. For the various usage settings, please refer to the corresponding circuit diagrams below.

Serial No.	Usage setting	Input type	Output type	Notes
3.2.1	Only for input	NPN		
3.2.2	Only for input	PNP		
3.2.3	Only for output		NPN	The output only supports NPN type.
3.2.4	Input and output	NPN	NPN	A set of 1k pull-up resistors needs to be installed for the input. The output only supports NPN type.
3.2.5	Input and output	PNP	NPN	The output only supports NPN type.

3.2.1 Only uses NPN input

This circuit diagram is only for the input signal and uses NPN type.

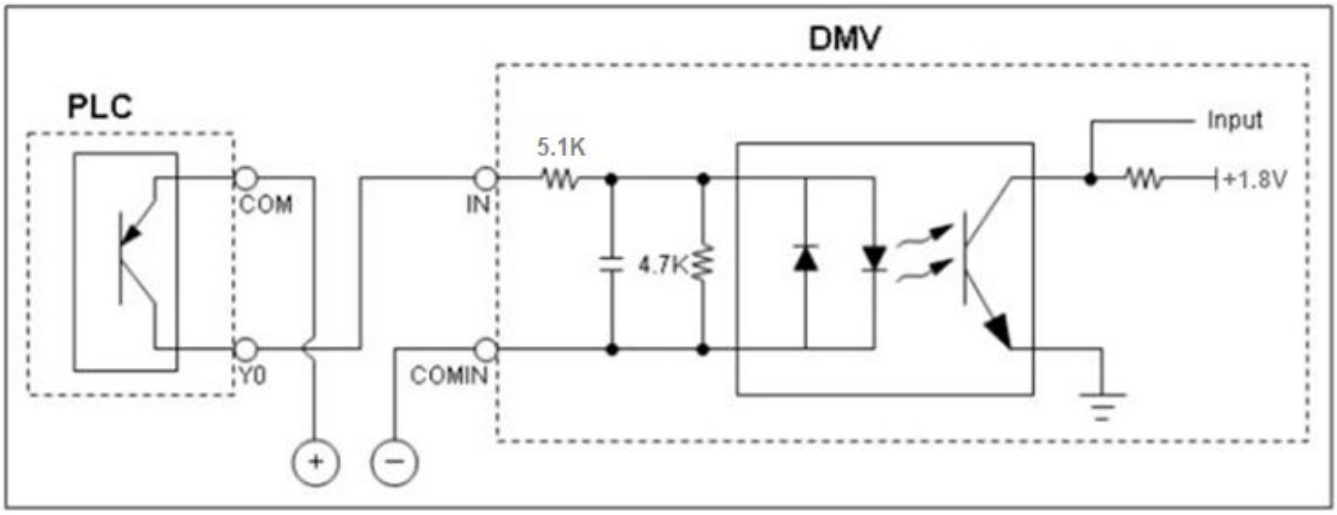
Input circuit diagram (NPN)



3.2.2 Only uses PNP input

This circuit diagram is only for the input signal and uses PNP type.

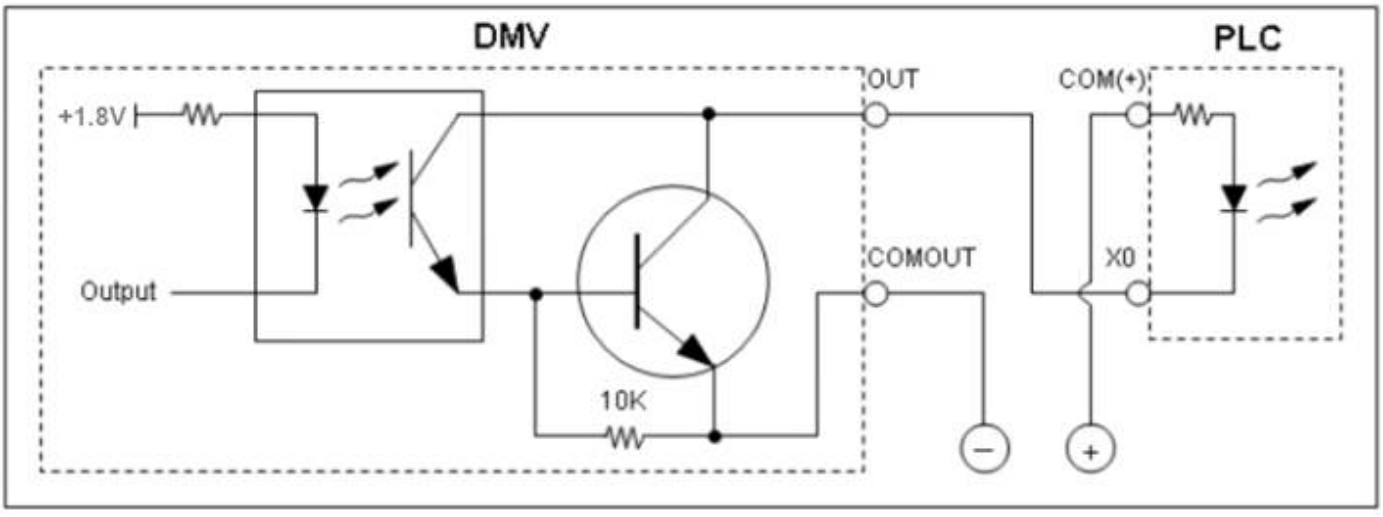
Input circuit diagram (PNP)



3.2.3 Only uses NPN output

This circuit diagram is only for the output signal and uses NPN type.

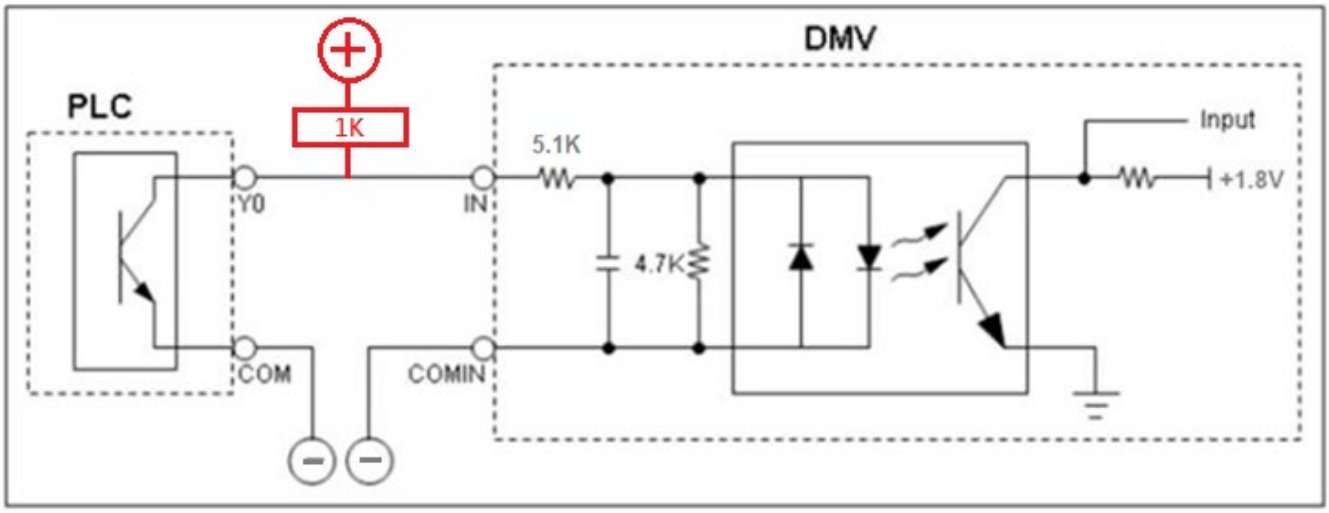
Output circuit diagram (NPN)



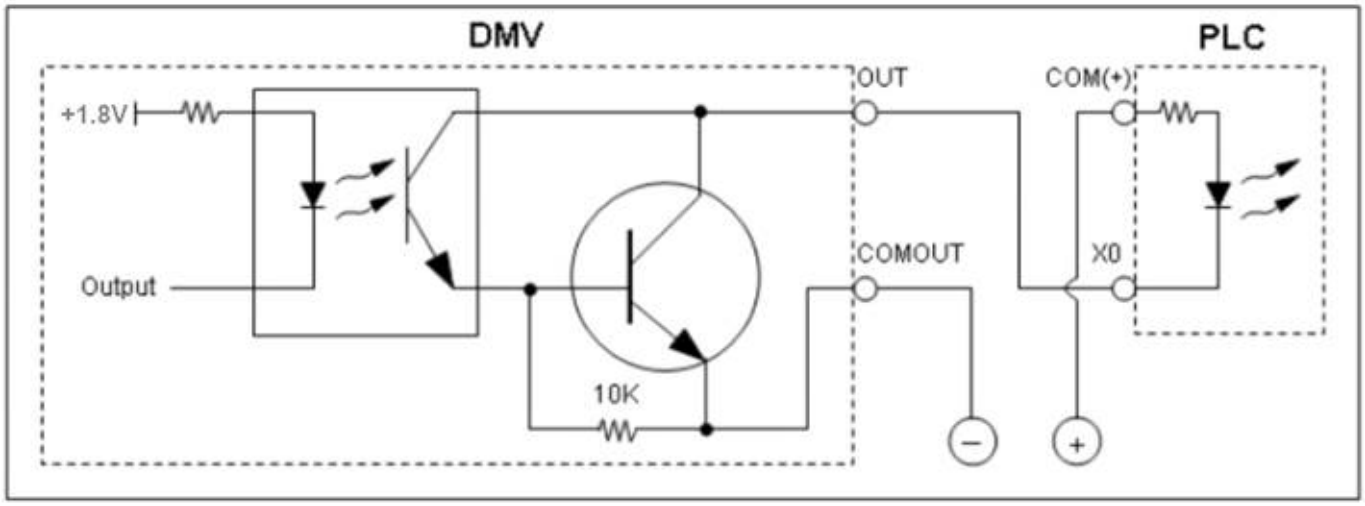
3.2.4 Uses Both NPN Input & NPN Output

This circuit diagram is for the input and output, and both signals use NPN type.
Note: Because the input and output of the DMV-C camera shares the I/O COM, when adopting this usage setting, a 1K pull-up resistor needs to be installed for the input.

Input circuit diagram (NPN)



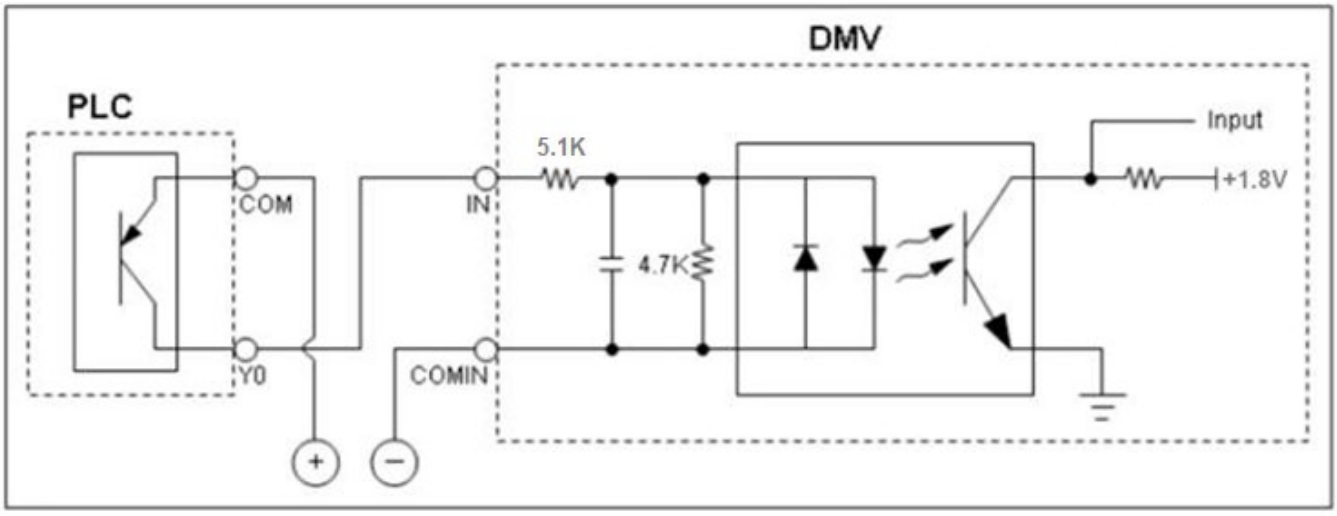
Output circuit diagram (NPN)



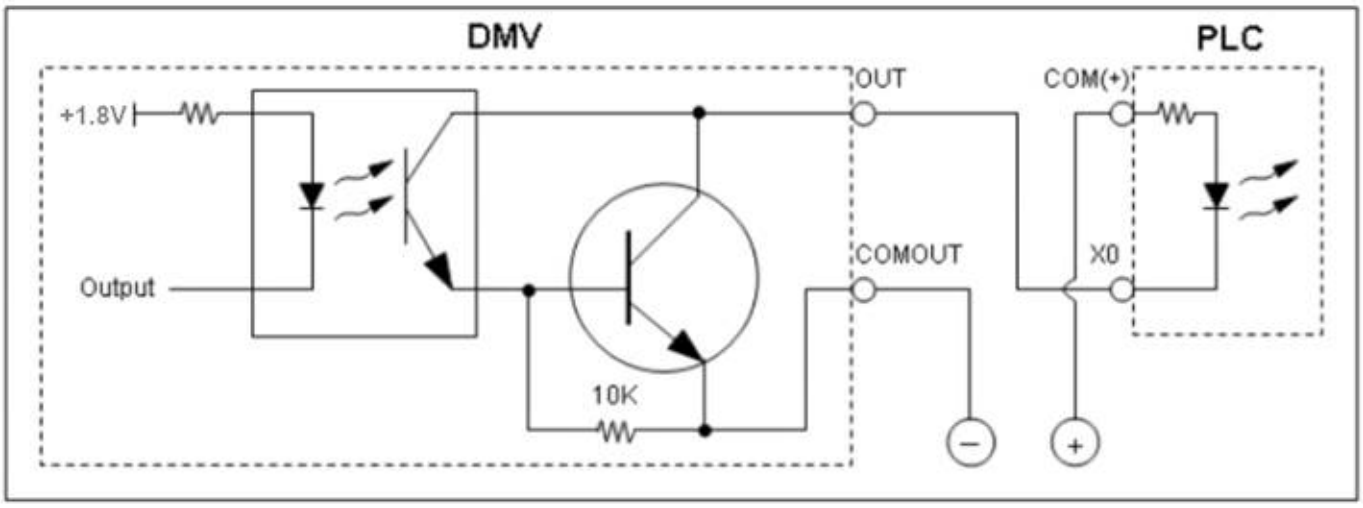
3.2.5 Uses PNP Input & NPN Output

This circuit diagram is for the input and output. The input uses PNP type and the output uses NPN type.

Input circuit diagram (PNP)



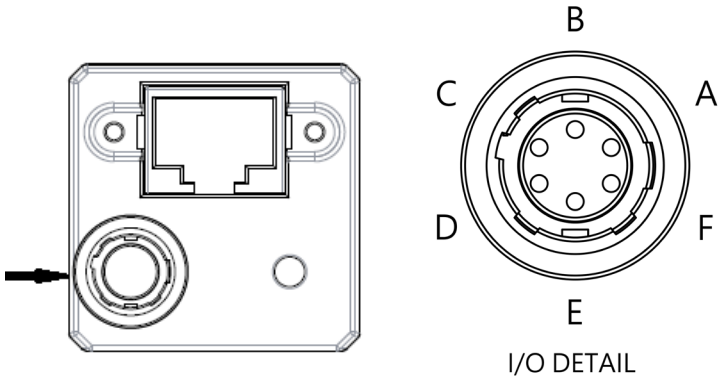
Output circuit diagram (NPN)



3.3 Input Function Settings

The DMV-C camera provides an OptoCoupled input circuit. External devices can use this circuit to trigger image capturing with the DMV-C camera.

The input and output signal line format of the DMV-C camera is based on an OptoCoupled design. Therefore, the user cannot customize the circuit input and output signals through other methods.



I/O DETAIL

Serial No.	Definition	Line selector
(B)	Input	Line
(E)	I/O common point	

The function parameters of the DMV-C camera comply with the naming conventions stipulated by GenICam. Each DMV-C camera contains an XML file. The XML file includes all function parameters of the camera. The user can read and write these function parameters to configure the camera.

The following input and output function settings section will provide a parameter function list, description of functions, and configuration process.
The function and parameter list includes the following five points:

1. Function name: Function names of the DMV-Viewer and SDK display.
2. Interface: IEnumeration, IFloat, IInteger, IBoolean, IString, ICommand.
3. Access: The user can access, read, or write this parameter.
4. Parameter level: Beginner, Expert, and Guru. When the visibility level is set to Beginner, the user will only be able to see the parameters of the Beginner level. If it is changed to Guru, the user can see all parameters.
5. Parameter content: Lists the values that will appear for each parameter. The values will vary depending on the parameter.

The table below is an example. The function name is exposure time and the interface used is IFloat. The user can access or write the function. The function is visible when the level is set to Beginner. The value write range is from 20 to 1000000 and the unit is μs.

Name	Interface	Access	Parameter Level	Parameter Content
Exposure Time	IFloat	Read/Write	Beginner	20~1000000

The parameter in the table below is the camera serial number. The interface used is IString. The user can only read the parameter and cannot write it. The visible level has to be set to Expert to see the parameter. The numerical result will be the camera serial number.

Name	Interface	Access	Parameter Level	Parameter Content
Device Serial Number	IString	Read	Expert	Device's serial number

3.3.1 Function parameters of the input settings

The input settings can be adjusted using the following function parameters.

Function Parameter List

Serial No.	Name	Interface	Access	Parameter Level	Parameter Content
1	Line Selector	IEnumeration	Read/Write	Expert	Line0 Line1 Line2
2	Line Mode	IEnumeration	Read/Write	Expert	Input Output
3	Line Inverter	IBoolean	Read/Write	Expert	True False
4	Line Status	IBoolean	Read	Expert	True False
5	Line Format	IEnumeration	Read/Write	Expert	Opto Coupled
6	Line Debounce Time	IFloat	Read/Write	Guru	Input unit Microsecond (μs)

Description of Functions

1. Line Selector: Select the line number for configuration.
   Line 1 = Input, red and white wire
   Line 2 = Output, black wire
   Line 3= Output, white wire
2. Line Mode: Output and input mode. The 3 pins have been defined for the DMV-C camera. This column only shows the I/O mode of the line number selected by Line Selector. For example, if the Line Selector selects Line0, Line Mode will show Input. If the Line Selector selects Line1, Line Mode will show Output.
3. Line Inverter: The input signal logic can be reversed after enabling. For example, the original low logic is inverted to high logic, and high logic is reversed to low logic. The function can be enabled or disabled according to the usage requirements.
4. Line Status: Displays the current status of the line selected by the Line Selector. True means high logic and False means low logic.
5. Line Format: Shows the line format selected by the Line Selector. The line formats for the DMV-C camera are OptoCoupled.
6. Line Debounce Time: Set the debounce time. Debounce can filter signal interference to avoid invalid signals from triggering the camera. When the input signal time is lower than the debounce time, the signal will not trigger the camera. Conversely, when the input signal time is equal to or greater than the debounce time, the signal will trigger image capturing by the camera. The unit for the time is microsecond (μs). For example, when using a mechanical

switch, quick connection or disconnection may occur easily. After setting the debounce time, the input signal time needs to be equal to or greater than the debounce time to trigger the camera.

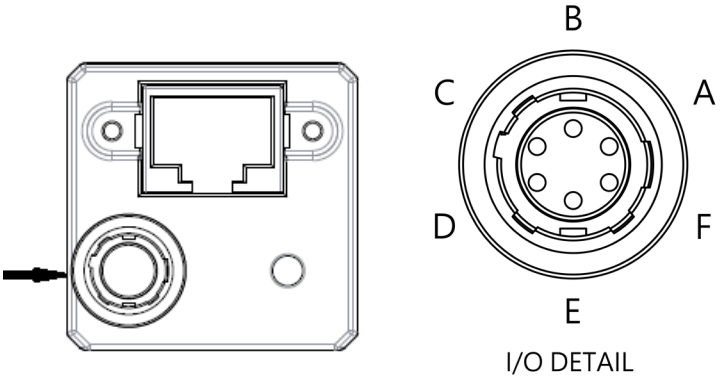
Input Configuration Process:

1. When using DMV-Viewer to enter input function settings, please go to Settings in Digital I/O Control.
2. Select Line 1 with Line Selector.
3. The Line Mode is fixed as input. After setting Line Selector, the Line Mode will be automatically displayed as input.
4. Use Line Inverter to set whether the input signal logic needs to be inverted.
5. The line format is set to OptoCoupled.
6. Use Line Debounce Time to set the debounce time.
7. Line Status can read the current status of the line. True means high logic and False means low logic.

3.4 Output Function Settings

The DMV-C camera provides two sets of OptoCoupled output lines and 7 output functions. The user uses the output signal to determine the specific status of the DMV-C.

The input and output signal line format of the DMV-C camera is based on an OptoCoupled design. Therefore, the user cannot customize the circuit input and output signals through other methods.



I/O DETAIL

Serial No.	Input and output	Line selector
(C)	Output	Line 3
(D)	Output	Line 2
(E)	I/O common point	Red and black

3.4.1 Function parameters of the output settings

The input function related parameters are listed as follows.

Function Parameter List

Serial No.	Name	Interface	Access	Parameter Level	Parameter Content
1	Line Source	IEnumeration	Read/Write	Expert	Off ExposureActive FrameTriggerWait AcquisitionTriggerWait UserOutput0 UserOutput1 FlashWindowActive ExternalTriggerActive
2	Line Min Pulse Width	IFloat	Read/Write	Guru	Input unit Microsecond (μs)

Description of Functions

1. Line Source: Selects the source of the output signal. Descriptions of the sources are as follows.

Serial No.	Output Source	Description of Functions
1	Exposure Active	When the camera performs exposure, a signal will be outputted until the exposure ends. This function can be used with flash for enabling and disabling.
2	Frame Trigger Wait	The camera is waiting for the frame start trigger signal.
3	Acquisition Trigger Wait	The camera is waiting for the acquisition start trigger signal.
4	User Output0	The user can set the signal to be outputted according to their requirements. This function can be integrated with other software for different applications. For example, it can be used with a visual software to output OK or NG signals. Please see Chapter 3.4.2 for the configuration method.
5	User Output1	Same as above.
6	Light Trigger (Flash Window)	The camera will output an interval signal to activate the flash. When used with a rolling shutter camera, the function can capture moving objects and prevent image distortion. In order to achieve this effect, a longer exposure time is required and the impact of ambient light should be avoided. The shortest exposure time for each model of camera to output flash signal is as follows: DMV-CL5M0：44000μs DMV-CL6M3：60000μs DMV-CL12M：124000μs DMV-CL20M0：198000μs
7	External Trigger Active	The camera is currently being triggered externally.

2. Line Min Pulse Width: Configure the minimum value of the camera output pulse width. When the receiver used needs a specific pulse width, this setting can be used to provide the value. Value 0 means the function is disabled. The unit for the function is microsecond (μs).

Output Configuration Process:

1. When using DMV-Viewer to enter output function settings, please go to Settings in Digital I/O Control.
2. Select Line2 or Line3 with Line Selector. When configuring, please note that the Output0 pin corresponds to Line1 and Output1 corresponds to Line2.
3. The Line Mode is fixed as output. After setting Line Selector, the Line Mode will be automatically displayed as output.
4. The output signal logic can be reversed after enabling Line Inverter. For example, the original low logic is inverted to high logic, and high logic is reversed to low logic. The function can be enabled or disabled according to the usage requirements.
5. Select the source of the output signal with Line Source.

6. The line format is set to OptoCoupled.
7. Line Min Pulse Width configures the minimum value of the camera output pulse width. When the receiver used needs a specific pulse width, this setting can be used to provide the value. Value 0 means the function is disabled. The unit for the function is microsecond (μs).

3.4.2 Description of user output settings

User output1 and user output2 allows the user to set the signal to be outputted according to their requirements. This function can be integrated with other software for different applications. For example, it can be used with a visual software to output OK or NG signals. The output signal can be configured individually or two at a time. The configuration process is as follows.

Function Parameter List

Serial No.	Name	Interface	Access	Parameter Level	Parameter Content
1	User Output Selector	IEnumeration	Read/Write	Expert	User Output1 User Output2
2	User Output Value	IBoolean	Read/Write	Expert	True False
3	User Output Value All	IInteger	Read/Write	Expert	0~3
4	User Output Value All Mask	IInteger	Read/Write	Expert	0~3

Single user output signal settings:

1. Use the User Output Selector to choose the signal source for configuration, User Output0 or User Output1.
2. Set User Output Value to True to output high logic signals and False to output low logic signals.

Dual user output signals settings:

1. User Output Value ALL can configure the output signals for user output1 and output2. When a specific value is set, it can control the output of both signal sources at the same time. For example, when 1 is entered, Output0 will output a high logic signal and Output1 will output a low logic signal. Please refer to the following table for the output signals corresponding to the entered values.
2. User Output Value All Mask is the mask setting. It can limit the values written by User Output Value All. For example, if the mask parameter is set to 2, the values that can be entered in User Output Value All are from 0 to 2. Entering 3 will have no effect. The mask function is only limited to User Output Value All. When the user directly sets the output signal through User Output Value, the mask will not limit the value.

Bit	Output1	Output2	Description
0	False	False	Output 1 logic low; Output 2 logic low
1	True	False	Output 1logic high; Output 2 logic low
2	False	True	Output 1 logic low; Output 2 logic high
3	True	True	Output 1 logic high; Output 2 logic high

Chapter 4

Function and Parameter Settings

This chapter will explain the function parameters within the DMV-C camera. The function parameters of the DMV-C camera comply with the naming conventions stipulated by GenICam. Each DMV-C camera contains an XML file. The XML file includes all function parameters of the camera. The user can read and write these function parameters to configure the camera.

The DMV-C camera currently provides 8 types of function parameters, including:

1. Device Control: Provides the general information of the DMV-C camera used, such as model number, camera version, and the user name of the camera.
2. Acquisition Control: Provides 3 major acquisition controls, including Acquisition & Frame Rate, Trigger Modes, and Exposure Modes.
3. Analog Control: Provides 5 major analog controls, including Gain, Black Level, Light Source, Balance White, and Gamma.
4. Image Format Control: Provides information on the charge-coupled device and image size to the user, and the ROI, mirror images, and output pixel format for configuring the camera.
5. LUT Control: The Lookup Table (LUT) settings can convert the original pixels to another pixel value.
6. User Set Control: Used to access and load camera parameters. The user can load default values or import customized parameters before loading.
7. Auto Function: Provides users with ROI settings for auto exposure and auto balance white, and can be used to configure the detailed parameters of auto exposure.
8. Transport Layer Control: Provides users with function parameters related to network settings. The user can use the function parameters in this chapter to configure the IP mode, GVCP, GVSP, and other settings.

Chapter 4 Function and Parameter Settings

Each section will provide a parameter function list, description of functions, and configuration process.

The function and parameter list includes the following five points:

1. Function name: Function names of the DMV-Viewer and SDK display.
2. Interface: IEnumeration, IFloat, IInteger, IBoolean, IString, ICommand.
3. Access: The user can access, read, or write this parameter.
4. Parameter level: Beginner, Expert, and Guru. When the visibility level is set to Beginner, the user will only be able to see the parameters of the Beginner level. If it is changed to Guru, the user can see all parameters.
5. Parameter content: Lists the values that will appear for each parameter. The values will vary depending on the parameter.

The table below is an example. The function name is exposure time and the interface used is IFloat. The user can access or write the function. The function is visible when the level is set to Beginner. The value write range is from 20 to 1000000 and the unit is μs.

Name	Interface	Access	Parameter Level	Parameter Content
Exposure Time	IFloat	Read/Write	Beginner	20~1000000

The parameter in the table below is the camera serial number. The interface used is IString. The user can only read the parameter and cannot write it. The visible level has to be set to Expert to see the parameter. The numerical result will be the camera serial number.

Name	Interface	Access	Parameter Level	Parameter Content
Device Serial Number	IString	Read	Expert	Device's serial number

4.1 Device Control

The Device Control page provides the general information of the DMV-C camera used, such as model number, camera version, and the user name of the camera.

4.1.1 Device Control Function Parameter

Function Parameter List

Serial No.	Name	Interface	Access	Parameter Level	Parameter Content
1	Device Scan Type	IEnumeration	Read	Expert	Area Scan
2	Vendor Name	IString	Read	Beginner	Delta Electronics
3	Model Name	IString	Read	Beginner	Model Name
4	Device Version	IString	Read	Beginner	v1.00
5	Device Serial Number	IString	Read	Expert	Device's serial number
6	Device User ID	IString	Read/Write	Beginner	Null
7	Device Reset	ICommand	Write	Guru	NA
8	Device Temperature	IFloat	Read	Expert	Degree C
9	Device Git Version	IString	Read	Beginner	Device Git Version

Description of Functions

1. Device Scan Type: The scanning form of the charge-coupled device. The DMV-C camera uses plane scanning charge-coupled devices.
2. Vendor Name: The vendor is Delta Electronics.
3. Model Name: Displays the model number of the camera.
4. Device Version: Displays the current firmware version of the camera.
5. Device Serial Number: Displays the serial number of the camera.
6. Device User ID: The user-defined device number, which is blank by default. The number will be written to the device and saved once a value is entered.
7. Device Reset: Resets the camera and automatically reboots it. After the reset, the camera needs to be searched for again to enable it. This setting does not restore the camera to the factory defaults.
8. Device Temperature: The core temperature in Celsius of the camera, not the surface temperature of the case.
9. Device Git Version: Displays the current Git version of the camera.

4.2 Acquisition Control

The user can set the acquisition and trigger modes in Acquisition Control.

Acquisition Control provides 3 major image capture controls:

1. Acquisition & Frame Rate: Acquisition mode and frame rate settings.
2. Trigger Modes: Trigger mode settings, including software trigger and I/O trigger.
3. Exposure Modes: Manual exposure time settings and auto exposure.

4.2.1 Acquisition & Frame Rate function parameters

Acquisition mode and frame rate settings.

Function Parameter List

Serial No.	Name	Interface	Access	Parameter Level	Parameter Content
1	Acquisition Mode	IEnumeration	Read/Write	Beginner	Continuous Single Frame Multi Frame
2	Acquisition Start	ICommand	Write	Beginner	NA
3	Acquisition Stop	ICommand	Write	Beginner	NA
4	Acquisition Frame Count	IInteger	Read/Write	Beginner	1~255
5	Acquisition Frame Rate Enable	IBoolean	Read/Write	Expert	True False
6	Acquisition Frame Rate	IFloat	Read/Write	Beginner	1~10000
7	Acquisition Frame Rate Result Max	IFloat	Read	Guru	Device-specific
8	Acquisition Frame Rate Abs	IFloat	Read	Guru	Device-specific

Description of Functions

1. Acquisition Mode: Supports 3 acquisition modes.
   Continuous: Continuous acquisition mode. It is the default mode.
   Single Frame: Captures a single image at a time.
   Multi Frame: Captures a specified number of images at a time. The number of images needs to be set through Acquisition Frame Count.
2. Acquisition Start: Starts image capture after execution.
3. Acquisition Stop: Image capture will stop after the current image is uploaded when executed.
4. Acquisition Frame Count: Sets the number of images to be captured each time. Used for Multi Frame mode.
5. Acquisition Frame Rate Enable: Limits the maximum frame rate of the camera when enabled.
6. Acquisition Frame Rate: Sets the upper limit of the camera frame rate. The unit is Hertz.
7. Acquisition Frame Rate Result Max: Shows the maximum frame rate, which is the current maximum that can be adjusted. The value will change when other parameters (such as exposure time) are changed.
8. Acquisition Frame Rate Abs: Shows the current actual frame rate.

4.2.2 Trigger Mode function parameters

Trigger mode settings, including software trigger and I/O trigger.

Function Parameter List

Serial No.	Name	Interface	Access	Parameter Level	Parameter Content
1	Trigger Mode	IEnumeration	Read/Write	Beginner	Off On
2	Trigger Selector	IEnumeration	Read/Write	Beginner	Acquisition start Frame start
3	Trigger Source	IEnumeration	Read/Write	Beginner	Software Line0
4	Trigger Software	ICommand	Write	Beginner	NA
5	Acquisition Status Selector	IEnumeration	Read/Write	Expert	Acquisition Trigger Wait Frame Trigger Wait
6	Acquisition Status	IBoolean	Read	Expert	True False
7	Trigger Activation	IEnumeration	Read/Write	Beginner	Rising edge Falling edge Any edge
8	Trigger Delay Enable	IBoolean	Read/Write	Expert	True False
9	Trigger Delay	IFloat	Read/Write	Expert	0~1000000

Description of Functions

1. Trigger Mode: Enable or disable trigger modes. After enabling, the trigger method needs to be configured.
2. Trigger Selector: Supports to two triggering methods, Acquisition Start or Frame Start. Please refer to 4.2.4 Acquisition Settings Usage Examples for the triggering methods.
3. Trigger Source: Sets the use of the internal software trigger or physical I/O signal trigger. Trigger Mode needs to be set to on.
4. Trigger Software: Performs trigger software when enabled.
5. Acquisition Status Selector: Choose the waiting for acquisition signal to be read. It must be selected using Trigger Selector. It can be set to Acquisition Trigger Wait or Frame Trigger Wait.
6. Acquisition Status: Shows the waiting for acquisition signal, which is a Boolean value. True means it is waiting for acquisition.
7. Trigger Activation: Configures the logic level of the physical I/O signal trigger.
    1. Rising Edge: Positive edge trigger.
    2. Falling Edge: Negative edge trigger
    3. Any Edge: Trigger on any edge.
8. Trigger Delay Enable: Enables trigger delay. The trigger delay time needs to be set after enabling.
9. Trigger Delay: Configures the delay time after triggering. The unit is microsecond (μs).

4.2.3 Exposure Modes function parameters

Manual exposure time settings and auto exposure.

Function Parameter List

Serial No.	Name	Interface	Access	Parameter Level	Parameter Content
1	Exposure Mode	IEnumeration	Read/Write	Beginner	Timed
2	Exposure Time	IFloat	Read/Write	Beginner	20~1000000
3	Exposure Time Abs	IFloat	Read	Guru	Device-specific
4	Exposure Auto	IEnumeration	Read/Write	Beginner	Off Once Continuous

Description of Functions

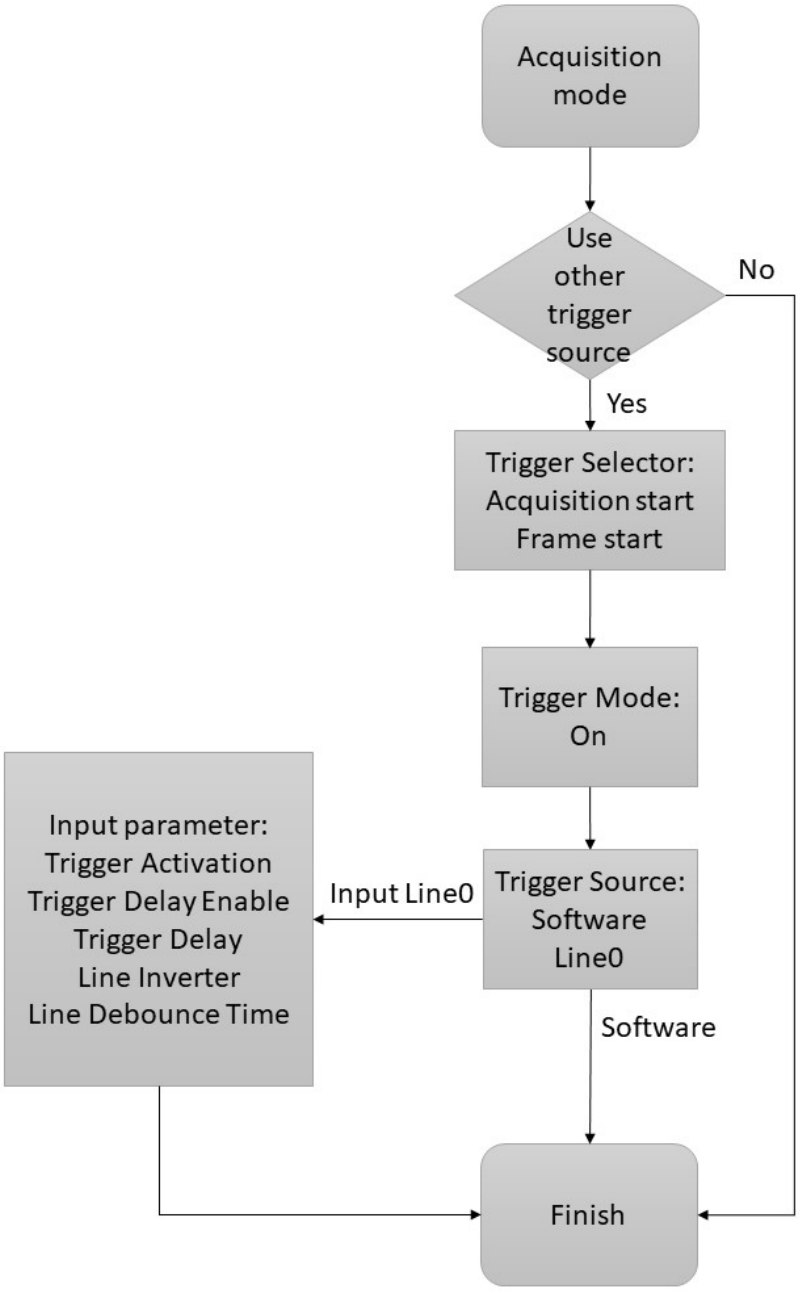
1. Exposure Mode: Sets the exposure mode and supports the Timed mode. After selecting Timed, Exposure Time needs to be configured. When using this mode, please disable Exposure Auto.
2. Exposure Time: Sets the exposure time of the camera. The unit is microsecond (μs). The exposure time range for the DMV-C series cameras is 20μs to 1s.
3. Exposure Time Abs: Shows the actual exposure time.
4. Exposure Auto: Automatic exposure mode. Single or continuous mode can be selected. For examples of Exposure Auto, please refer to Chapter 4.7.
   Off: Disable auto exposure function.
   Once: Single mode. After execution, the DMV-C will perform Exposure Auto once. Exposure Auto will be disabled after execution.
   Continuous: Continuous mode. After execution, the DMV-C will continuously perform Exposure Auto.

4.2.4 Acquisition Control usage example

The acquisition modes and trigger modes of the DMV-C camera can be combined into various usage methods, and applied in various settings.

Before configuring acquisition settings, the user can refer to the following process chart to set the various function parameters. The chapter will provide 9 acquisition settings examples.

Acquisition Settings Process Chart



Acquisition Settings Example 1

Acquisition mode: Continuous

Trigger mode: Acquisition Start

Trigger source: Trigger Software

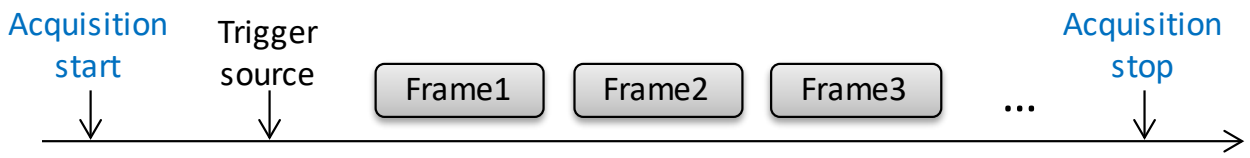
Parameter setting:

Function name	Parameters
Acquisition mode	Continuous
Trigger mode	On
Trigger Selector	Acquisition Start
Acquisition Status Selector	Acquisition Trigger Wait
Trigger Source	Software

Run process:

1. Execute “Acquisition Start"
2. "Acquisition Status" signal switches to True
3. Execute “Trigger Software”. The camera will start to capture images continuously.
4. Execute “Acquisition Stop". The camera stops acquisition

Run icon:



Note: When using continuous acquisition mode, the camera frame rate can be configured. The parameters are Acquisition Frame Rate Enable and Acquisition Frame Rate in 4.2.1.

Acquisition Settings Example 2

Acquisition mode: Continuous

Trigger mode: Frame Start

Trigger source: External I/O trigger

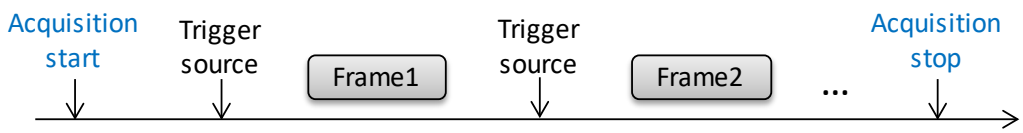
Parameter setting:

Function name	Parameters
Acquisition mode	Continuous
Trigger mode	On
Trigger Selector	Frame Start
Acquisition Status Selector	Frame Trigger Wait
Trigger Source	Input Line0

Run process:

1. Execute “Acquisition Start"
2. After "Acquisition Status" is switched to True
3. The camera will capture an image once when “I/O trigger” is executed.
4. After "Acquisition Status" is switched to True
5. The camera will capture an image once again when “I/O trigger” is executed.
6. ……
7. Execute “Acquisition Stop". The camera stops acquisition

Run icon:



Acquisition Settings Example 3

Acquisition mode: Continuous

Trigger mode: Not enabled

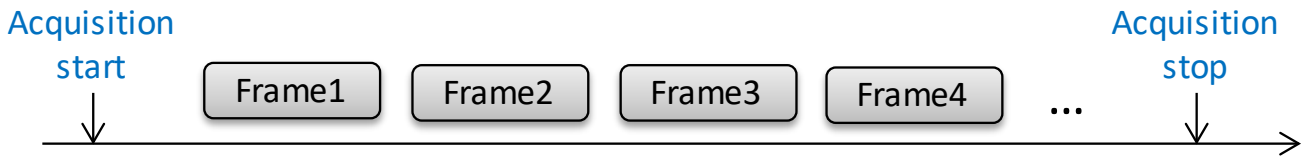
Parameter setting:

Function name	Parameters
Acquisition mode	Continuous
Trigger mode	Off
Trigger Selector	NA
Acquisition Status Selector	NA
Trigger Source	NA

Run process:

1. Execute “Acquisition Start”. The camera will start to capture images continuously.
2. Execute “Acquisition Stop". The camera stops acquisition

Run icon:



Acquisition Settings Example 4

Acquisition mode: Single Frame

Trigger mode: Acquisition Start

Trigger source: External I/O trigger

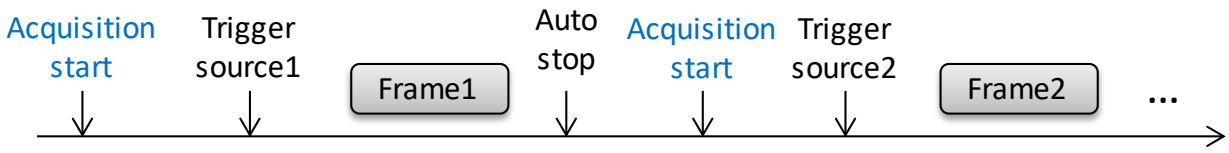
Parameter setting:

Function name	Parameters
Acquisition mode	Single Frame
Trigger mode	On
Trigger Selector	Acquisition Start
Acquisition Status Selector	Acquisition Trigger Wait
Trigger Source	Input Line0

Run process:

1. Execute “Acquisition Start"
2. "Acquisition Status" signal switches to True
3. The camera will capture an image once and automatically stop when “I/O trigger” is executed.

Run icon:



Acquisition Settings Example 5

Acquisition mode: Single Frame

Trigger mode: Frame Start

Trigger source: Trigger Software

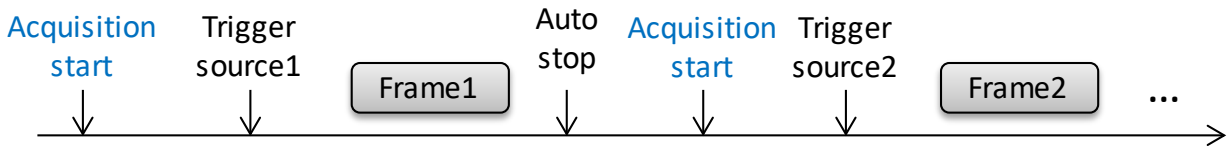
Parameter setting:

Function name	Parameters
Acquisition mode	Single Frame
Trigger mode	On
Trigger Selector	Frame Start
Acquisition Status Selector	Frame Trigger Wait
Trigger Source	Software

Run process:

1. Execute “Acquisition Start"
2. "Acquisition Status" signal switches to True
3. The camera will capture an image once and automatically stop when “Trigger Software” is executed.

Run icon:



Acquisition Settings Example 6

Acquisition mode: Single Frame

Trigger mode: Not enabled

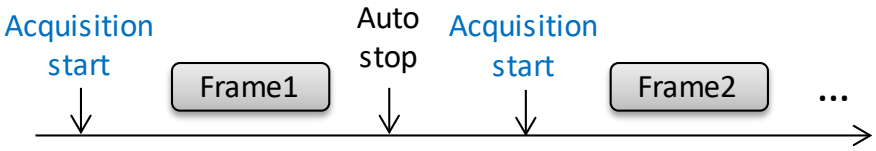
Parameter setting:

Function name	Parameters
Acquisition mode	Single Frame
Trigger mode	Off
Trigger Selector	NA
Acquisition Status Selector	NA
Trigger Source	NA

Run process:

1. The camera will capture an image once and automatically stop when “Acquisition Start” is executed.

Run icon:



Acquisition Settings Example 7

Acquisition mode: Multi Frame

Trigger mode: Acquisition Start

Trigger source: Trigger Software

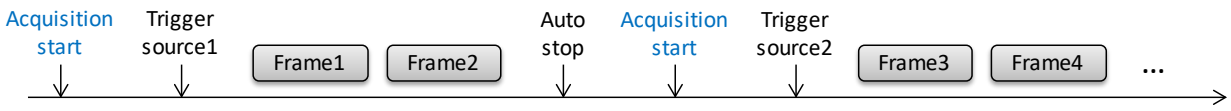
Parameter setting:

Function name	Parameters
Acquisition mode	Multi Frame
Acquisition Frame Count	2
Trigger mode	On
Trigger Selector	Acquisition Start
Acquisition Status Selector	Acquisition Trigger Wait
Trigger Source	Software

Run process:

1. Execute “Acquisition Start"
2. "Acquisition Status" signal switches to True
3. The camera will capture two images and automatically stop when “Trigger Software” is executed.

Run icon:



Acquisition Settings Example 8

Acquisition mode: Multi Frame

Trigger mode: Frame Start

Trigger source: External I/O trigger

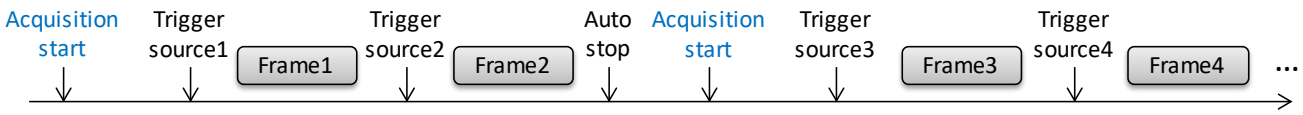
Parameter setting:

Function name	Parameters
Acquisition mode	Multi Frame
Acquisition Frame Count	2
Trigger mode	On
Trigger Selector	Frame Start
Acquisition Status Selector	Frame Trigger Wait
Trigger Source	Input Line0

Run process:

1. Execute “Acquisition Start"
2. "Acquisition Status" signal switches to True
3. The camera will capture an image once when “I/O trigger” is executed.
4. "Acquisition Status" signal switches to True
5. The camera will capture the second image and automatically stop after two images are captured when “I/O trigger” is executed.

Run icon:



Acquisition Settings Example 9

Acquisition mode: Multi Frame

Trigger mode: Not enabled

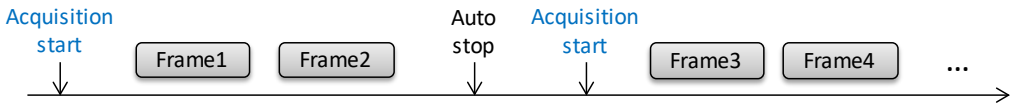
Parameter setting:

Function name	Parameters
Acquisition mode	Multi Frame
Acquisition Frame Count	2
Trigger mode	Off
Trigger Selector	NA
Acquisition Status Selector	NA
Trigger Source	NA

Run process:

1. The camera will capture two images and automatically stop when “Acquisition Start” is executed.

Run icon:



4.3 Analog Control

Analog control provides 5 types of analog controls:

1. Gain: Increasing gain can increase the overall brightness of the image while increasing image noise.
2. Black Level: Adjusts the grayscale value offset for all pixels in the image and enhances the grayscale value of all pixels. The image's brightness is adjusted through this method.
3. Light Source: The color shift caused by a specific light source can be corrected through this function to optimize the color performance. The user can choose sunlight 5000, 6500 Kelvin or define their own ambient light source. Light source is set as 6500 Kelvin by default.
4. Balance White: With balance white control, the user can manually adjust the RGB values or use auto balance white.
5. Gamma: Gamma calibration can optimize the brightness of the image and is used in overly bright or dark images. The user can customize the calibration value. Gamma is set as sRGB by default.

4.3.1 Gain function parameters

Increasing gain can increase the overall brightness of the image while increasing image noise.

Function Parameter List

Serial No.	Name	Interface	Access	Parameter Level	Parameter Content
1	Gain Selector	IEnumeration	Read/Write	Beginner	All
2	Gain	IFloat	Read/Write	Beginner	Device-specific
3	Gain Raw	IInteger	Read/Write	Beginner	Device-specific

Description of Functions

1. Gain Selector: Selects the gain value of the control. Only supports all. Adjusts the gain of all channels simultaneously.
2. Gain: The gain value can be adjusted through gain or the gain raw for the next parameter. The two parameters correspond to each other. The difference is that the format of the gain adjustment is a floating value and the gain raw adjustment is an integer. The adjustable values supported by different DMV-C models will vary by model number.

Note: The unit for gain is db.

3. Gain Raw: Enter the gain value to be adjusted. The value inputted should be an integer. The adjustable values supported by different DMV-C models will vary by model number.

Configuration Process

1. Set Gain Selector to select All.
2. Enter the gain value or gain raw value to adjust to a suitable image.

4.3.2 Black Level function parameters

Enter the Black Level to adjust the grayscale value offset for all pixels in the image and enhance the grayscale value of all pixels. The image's brightness is adjusted through this method.

Function Parameter List

Serial No.	Name	Interface	Access	Parameter Level	Parameter Content
1	Black Level Selector	IEnumeration	Read/Write	Expert	Black level all
2	Black Level Raw	IInteger	Read/Write	Beginner	0~255

Description of Functions

1. Black Level Selector: Select the Black Level channel to be controlled. Only supports Black Level All to offset the black level of all channels simultaneously.
2. Black Level Raw: Enter the black level value to be adjusted. The input format is an integer value.

Configuration Process

1. Set the Black Level Selector and choose Black Level All.
2. Enter the offset in Black Level Raw to adjust to a suitable image.

4.3.3 Light Source function parameters

The color shift caused by a specific light source can be corrected through this function to optimize the color performance. The user can choose sunlight 5000, 6500 Kelvin or define their own ambient light source.

Function Parameter List

Serial No.	Name	Interface	Access	Parameter Level	Parameter Content
1	Light Source Selector	IEnumeration	Read/Write	Expert	Off Day light 5000 Kelvin Day light 6500 Kelvin Custom
2	Color Transformation Value Selector	IEnumeration	Read/Write	Expert	Gain00 Gain01 Gain02 Gain10 Gain11 Gain12 Gain20 Gain21 Gain22
3	Color Transformation Value	IFloat	Read/Write	Expert	-8 ~ 7.96875

Description of Functions

1. Light Source Selector：Ambient light source selection, selects the current ambient light source for color offset correction, and optimizes color performance. If the user has performed automatic white balance or manually adjusted R, G, and B values, the user needs to perform automatic white balance again or manually adjust R, G, and B after adjusting the Light Source.

Day light 5000 Kelvin: Adjusts the color shift caused by the ambient light source color temperature 5000K.

Day light 6500 Kelvin: Adjusts the color shift caused by the ambient light source color temperature 6500K.

Custom: Manually performs color shift correction for ambient light. When this option is selected, the user needs to manually define the values in the color conversion matrix. The color conversion matrix is a set of 3x3 matrices.

$$\begin{bmatrix} Gain00 & Gain01 & Gain02 \\ Gain10 & Gain11 & Gain12 \\ Gain20 & Gain21 & Gain22 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix} = \begin{bmatrix} R" \\ G" \\ B" \end{bmatrix}$$

2. Color Transformation Value Selector: Selects a matrix location, for example, select Gain00.
3. Color Transformation Value: Enters a value for the matrix position selected by the Color Transformation Value Selector, and the value range is -8~7.96875.

4.3.4 Balance White function parameters

With balance white control, the user can manually adjust the RGB values or use auto balance white.

Function Parameter List

Serial No.	Name	Interface	Access	Parameter Level	Parameter Content
1	Balance Ratio Selector	IEnumeration	Read/Write	Expert	Red Green Blue
2	Balance Ratio (R, G, B)	IFloat	Read/Write	Expert	0~15.9997
3	Balance Ratio Raw	IInteger	Read/Write	Expert	0~65535
4	Balance White Auto	IEnumeration	Read/Write	Expert	Off Once Continuous

Description of Functions

1. Balance Ratio Selector: Chooses the R, G, and B channels for Balance White adjustment in manual mode.
2. Balance Ratio (R, G, B): Enters the balance ratio according to the channels (R, G, and B) selected in Balance Ratio Selector. The input format is floating point number with a range of 0 to 15.9997.

3. Balance Ratio Raw: Enters the balance ratio according to the channels (R, G, and B) selected in Balance Ratio Selector. The input format is an integer value. The parameter corresponds to the Balance Ratio. The difference between the two is 4096 times and the range is 0 to 65535.
4. Balance White Auto: Auto balance white.

   Off: Disables auto balance white function.

   Once: Single mode. After execution, the industrial camera will perform Balance White Auto once. Balanced White Auto will be disabled after execution.

   Continuous: Continuous mode. After execution, the industrial camera will continuously perform Balance White.

Configuration Process - Manual Balance White

1. Set the Balance Ratio Selector and select the color channels (red, green, and blue) for manual balance white.
2. Enter a specific Balance Ratio value or Balance Ratio Raw value.

   When Balance Ratio is equal to 1, the color intensity will not change.

   When Balance Ratio is less than 1, the color intensity will decrease.

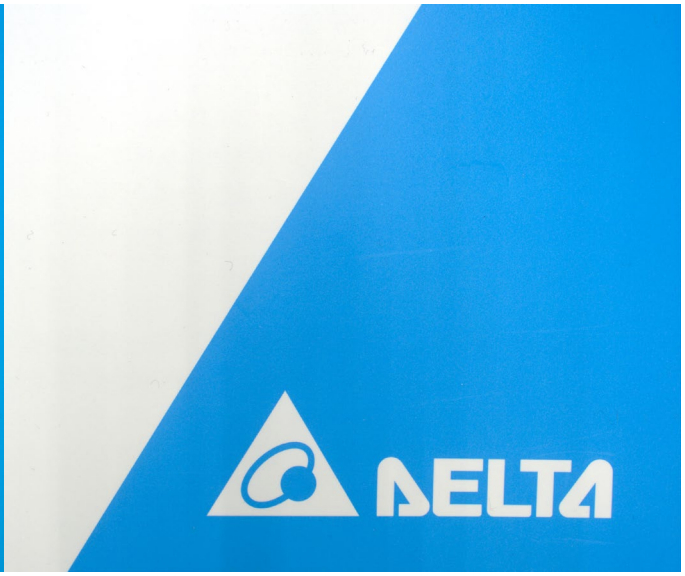
   When Balance Ratio is greater than 1, the color intensity will increase.

Configuration Process - Auto Balance White

When using balance white auto, the camera will perform balance white auto for the image captured and generate an image after balance white.

1. Set the ROI for auto functions (refer to 4.7) to set the ROI to an area close to white on the screen.
2. Set Balance White Auto and choose Once or Continuous according to user needs.
3. The result after execution is as follows

Before balance white



After balance white

4.3.5 Gamma function parameters

Gamma calibration can optimize the brightness of the image and is used in overly bright or dark images. The user can customize the calibration value. Gamma is set as sRGB by default.

Function Parameter List

Serial No.	Name	Interface	Access	Parameter Level	Parameter Content
1	Gamma Enable	IBoolean	Read/Write	Beginner	True/False
2	Gamma Selector	IEnumeration	Read/Write	Beginner	User sRGB
3	Gamma	IFloat	Read/Write	Beginner	0~4

Description of Functions

1. Gamma Enable: Enables gamma.
2. Gamma Selector: Selects the gamma mode and supports user customized modes or sRGB.
   User: The user can input their own adjustment values.
   sRGB: Standard RGB format.
3. Gamma: Enters the gamma value.

Configuration Process

1. Enable Gamma Enable.
2. Select the mode with Gamma Selector, either user defined or sRGB. If user is selected, please continue process 3. If sRGB is selected, the sRGB values will be directly imported.
3. Enter the value in Gamma.
   When Gamma is equal to 1, the image will not change.
   When Gamma is less than 1, the overall brightness of the image will increase.
   When Gamma is greater than 1, the overall brightness of the image will decrease.

Gamma=1

Gamma=0.5

Gamma=3.5

Gamma=sRGB

4.4 Image Format Control

Image Format Control provides information on the charge-coupled device and image size to the user, and the ROI, mirror images, and output pixel format for configuring the camera.

4.4.1 Charge-coupled device function parameters

Shows charge-coupled device and image information.

Function Parameter List

Serial No.	Name	Interface	Access	Parameter Level	Parameter Content
1	Sensor Width	IInteger	Read	Expert	Device-specific
2	Sensor Height	IInteger	Read	Expert	Device-specific
3	Width Max	IInteger	Read	Expert	Device-specific
4	Height Max	IInteger	Read	Expert	Device-specific

Description of Functions

1. Sensor Width: Shows the width of the camera’s charge-coupled device.
2. Sensor Height: Shows the height of the camera’s charge-coupled device.
3. Width Max: Maximum width of the automatically displayed image.
4. Height Max: Maximum height of the automatically displayed image.

4.4.2 Camera ROI settings function parameters

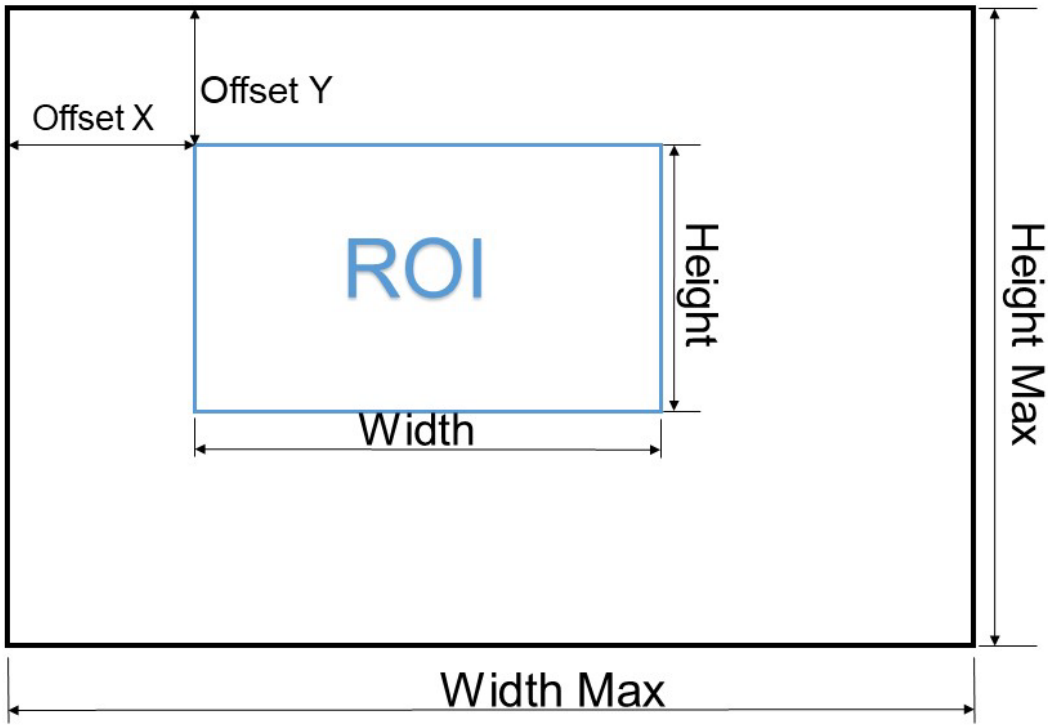
In Region of Interest (ROI) settings of the camera, the user can define the ROI of the image. After capturing the image, the camera will only process the pixels in the ROI. The unit for ROI is pixel.

Function Parameter List

Serial No.	Name	Interface	Access	Parameter Level	Parameter Content
1	Width	IInteger	Read/Write	Beginner	Device-specific
2	Height	IInteger	Read/Write	Beginner	Device-specific
3	Offset X	IInteger	Read/Write	Beginner	>=0
4	Offset Y	IInteger	Read/Write	Beginner	>=0

Description of Functions

1. Width: Camera ROI width setting. Note: The configurable range of Width is Width Max - Offset X.
2. Height: Camera ROI height setting. Note: The configurable range of Height is Height Max - Offset Y.
3. Offset X: X-axis origin of the ROI.
4. Offset Y: Y-axis origin of the ROI.



4.4.3 Mirror settings function parameters

X- and Y-axis mirror settings.

Function Parameter List

Serial No.	Name	Interface	Access	Parameter Level	Parameter Content
1	Reverse X	IBoolean	Read/Write	Expert	True/False
2	Reverse Y	IBoolean	Read/Write	Expert	True/False

Description of Functions

1. Reverse X: The image is flipped horizontally. If an ROI is configured, the ROI will be applied to the flipped image.
2. Reverse Y: The image is flipped vertically. If an ROI is configured, the ROI will be applied to the flipped image.

Configuration Process

1. Enable Reverse X, Reverse Y, or both functions.

Original image

Reverse X

Reverse Y

Reverse X & Y

4.4.4 Pixel Format function parameters

Set the pixel format of the camera output.

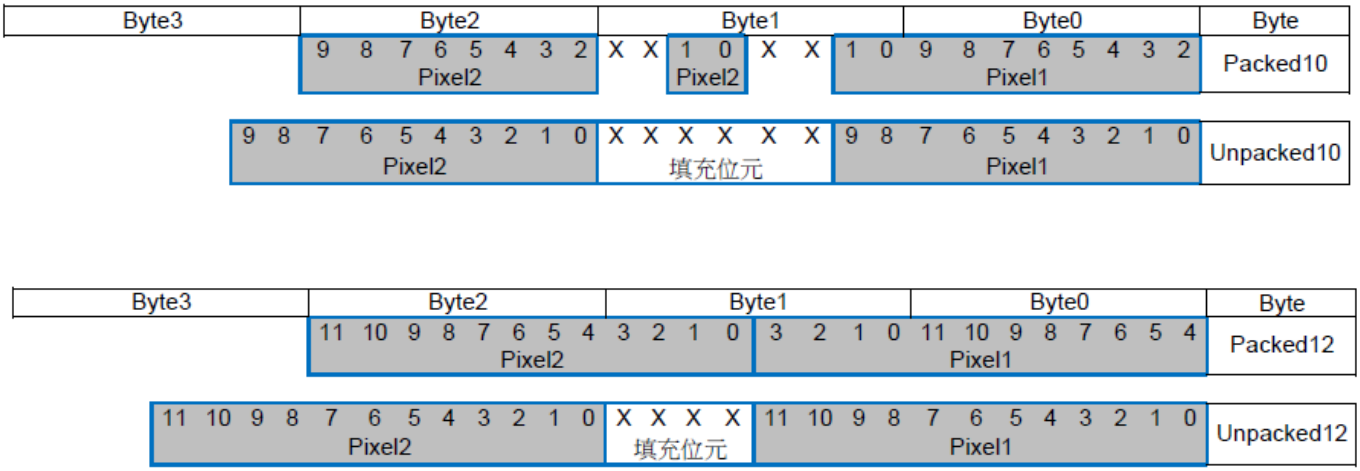
Function Parameter List

Serial No.	Name	Interface	Access	Parameter Level	Parameter Content
1	Pixel Format	IEnumeration	Read/Write	Beginner	Gray scale type: Mono 8 Mono 10 Mono 10 Packed Mono 12 Mono 12 Packed
					Color type: Bayer RG 8 Bayer RG 10 Bayer RG 10 Packed Bayer RG 12 Bayer RG12 Packed
2	Pixel Size	IEnumeration	Read/Write	Expert	8 Bits/Pixel 10 Bits/Pixel 12 Bits/Pixel

Description of Functions

1. Pixel Format: Configures the pixel format of the camera output. The pixel format for grayscale models is Mono and the pixel format for color models is Bayer. The outputs are 8, 10, or 12 Bits/Pixel.

   The difference between packed and unpacked output formats is when the pixels are transmitted, unpacked will add filler bits to fill the remaining bits in a byte, and transmit the next pixel in a new byte. Packed will transmit the next pixel in the same byte. The figure below shows 10 bits and 12 bits packed and unpacked formats.



2. Pixel Size: Shows the size of each pixel in bits. After selecting the pixel format, pixel size can be used to check the corresponding pixel size.

4.4.5 Test Pattern function parameters

The camera will return a test pattern internally for testing by the user to confirm the status of the camera.

Function Parameter List

Serial No.	Name	Interface	Access	Parameter Level	Parameter Content
1	Test Pattern Generator Selector	IEnumeration	Read/Write	Beginner	Sensor
2	Test Pattern	IEnumeration	Read/Write	Beginner	Off Color Bar Grey Grey Horizontal Ramp Grey Vertical Ramp

Description of Functions

1. Test Pattern Generator Selector: Sensor: Complete charge-coupled device area.
2. Test Pattern: The return image options are as follows. Different charge-coupled devices support different images.

   Grey: The charge-coupled device returns a full gray image.

   Color Bar: The charge-coupled device returns an image of colored vertical stripes.

Grey Horizontal Ramp: The charge-coupled device returns an image of a gray horizontal gradient.

Grey Vertical Ramp: The charge-coupled device returns an image of a gray vertical gradient.

4.5 LUT Control

The Lookup Table (LUT) allows the user to establish a pixel index table, converting specific pixels into another specified pixel.

4.5.1 LUT Control function parameters

Function Parameter List

Serial No.	Name	Interface	Access	Parameter Level	Parameter Content
1	LUT Enable	IBoolean	Read/Write	Guru	True False
2	LUT Index	IInteger	Read/Write	Guru	Device-specific
3	LUT Value	IInteger	Read/Write	Guru	Device-specific

Description of Functions

1. LUT Enable: Enables LUT Control functions after startup.
2. LUT Index: Selects the index value for conversion.
3. LUT Value: Enters the pixel value after conversion.

Configuration Process

1. Enter the specified pixel in LUT Index, such as 200
2. Enter the conversion pixel in LUT Value, such as 0. The original pixel 200 on the screen will be converted to pixel 0.
3. Repeat steps 1 and 2 until the configuration is complete
4. Select LUT Enable in LUT Control
5. Save LUT

The pixel range will vary according to the pixel format used. Please refer to the table below.

Color camera pixel format	Gray scale camera pixel format	Pixel range
Bayer RG 8	Mono 8	0~255
Bayer RG 10	Mono 10	0~1023
Bayer RG 12	Mono 12	0~4095

Example

The following example uses the LUT function to convert the original pixels 90 to 110 to pixel 255, emphasizing the white areas on the screen.

1. Enter the specified pixel value, 90, in LUT Index.
2. Enter the conversion pixel value, 255, in LUT Value.
3. Repeat steps 1 and 2 until pixels 90 to 110 are assigned to pixel 255.
4. Select LUT Enable in LUT Control

Original image

Assign pixels 90 to 110 to pixel 255 through LUT

If you wish to save the LUT, you can use the internal functions of User Set Control to save the file. In the future, you can continue using the LUT by loading this file. Please refer to Chapter 4.6 for the description of User Set Control.

5. To save the LUT, select a User set (4 sets are provided) from User Set Selector, such as UserSet1, and click User Set Save to save.
6. To load the LUT, select the User Set and click User Set Load to load.

4.6 User Set Control

User Set Control is used to access and load camera parameters. The user can load default values or import customized parameters before loading.

4.6.1 User mode function parameters

Serial No.	Name	Interface	Access	Parameter Level	Parameter Content
1	User Set Selector	IEnumeration	Read/Write	Beginner	Default High Gain Raw Color User Set1 User Set2 User Set3 User Set4
2	User Set Load	ICommand	Write	Guru	NA
3	User Set Save	ICommand	Write	Guru	NA
4	User Set Default	IEnumeration	Read/Write	Beginner	Default High Gain Raw Color User Set1 User Set2 User Set3 User Set4

Description of Functions

1. User Set Selector: Select the user mode to access or edit.
   Default: Default mode.
   High Gain: High gain mode.
   Raw Color: Original color mode, only supported for color cameras.
   User Set1: User 1.
   User Set2: User 2.
   User Set3: User 3.
   User Set4: User 4.
2. User Set Load: Load the user parameters selected in User Set Selector.

3. User Set Save: Save the user parameters selected in User Set Selector.
4. User Set Default: Set the default mode after camera startup.

User Set can save most camera parameters, the parameters that can be saved by User Set are as follows:

Serial No.	Category	Name	Interface	Access	Parameter Level	Parameter Content
1	Image Format Control	Width	IInteger	Read/Write	Beginner	Device-specific
2		Height	IInteger	Read/Write	Beginner	Device-specific
3		Offset X	IInteger	Read/Write	Beginner	>=0
4		Offset Y	IInteger	Read/Write	Beginner	>=0
5		Pixel Format	IEnumeration	Read/Write	Beginner	Mono model： Mono 8 Mono 10 Mono 10 Packed Mono 12 Mono 12 Packed
						Color model： Bayer RG 8 Bayer RG 10 Bayer RG 10 Packed Bayer RG 12 Bayer RG12 Packed
6		Reverse X	IBoolean	Read/Write	Expert	True/False
7		Reverse Y	IBoolean	Read/Write	Expert	True/False
8		Test Pattern	IEnumeration	Read/Write	Beginner	Off Color Bar Grey Grey Horizontal Ramp Grey Vertical Ramp
9	Acquisition Control	Acquisition Frame Rate	IFloat	Read/Write	Beginner	1~10000
10		Acquisition Frame Rate Enable	IBoolean	Read/Write	Expert	True False
11		Acquisition Frame Count	IInteger	Read/Write	Beginner	1~255
12		Acquisition Mode	IEnumeration	Read/Write	Beginner	Continuous Single Frame

						Multi Frame
13		Trigger Delay. (Acquisition Start)	IFloat	Read/Write	Expert	0~1000000
14		Trigger Delay Enable (Acquisition Start)	IBoolean	Read/Write	Expert	True False
15		Trigger Source (Frame Start)	IEnumeration	Read/Write	Beginner	Software Line0
16		Trigger Activation (Frame Start)	IEnumeration	Read/Write	Beginner	Rising edge Falling edge Any edge
17		Trigger Delay (Frame Start)	IFloat	Read/Write	Expert	0~1000000
18		Trigger Delay Enable (Frame Start)	IBoolean	Read/Write	Expert	True False
19		Trigger Mode (Frame Start)	IEnumeration	Read/Write	Beginner	Off On
20		Exposure Time	IFloat	Read/Write	Beginner	20~1000000
21	Analog Control	Gain Raw	IInteger	Read/Write	Beginner	Device-specific
22		Black Level Raw	IInteger	Read/Write	Beginner	0~255
23		User Set Selector	IEnumeration	Read/Write	Beginner	Default High Gain Raw Color User Set1 User Set2 User Set3 User Set4
24		Balance Ratio (R, G, B)	IFloat	Read/Write	Expert	0~15.9997
25		Balance Ratio Raw	IInteger	Read/Write	Expert	0~65535
26		Gamma Selector	IEnumeration	Read/Write	Beginner	User sRGB
27		Gamma Enable	IBoolean	Read/Write	Beginner	True/False
28		Gamma	IFloat	Read/Write	Beginner	0~4

29		Light Source Selector	IEnumeration	Read/Write	Expert	Off Day light 5000 Kelvin Day light 6500 Kelvin Custom
30		Balance White Auto	IEnumeration	Read/Write	Expert	Off Once Continuous
31	LUT Control	LUT Enable	IBoolean	Read/Write	Guru	True False
32		LUT Index	IInteger	Read/Write	Guru	Device-specific
33	Auto Function	ROI Width	IInteger	Read/Write	Beginner	Device-specific
34		ROI Height	IInteger	Read/Write	Beginner	Device-specific
35		ROI Offset X	IInteger	Read/Write	Beginner	Device-specific
36		ROI Offset Y	IInteger	Read/Write	Beginner	Device-specific
37	I/O Control	Line Inverter (Line1)	IBoolean	Read/Write	Expert	True False
38		Line Inverter (Line2)	IBoolean	Read/Write	Expert	True False
39		Line Inverter (Line3)	IBoolean	Read/Write	Expert	True False
40		Line Source (Line2)	IEnumeration	Read/Write	Expert	Off ExposureActive FrameTriggerWait AcquisitionTriggerWait UserOutput0 UserOutput1 FlashWindowActive ExternalTriggerActive
41		Line Source (Line2)	IEnumeration	Read/Write	Expert	Off ExposureActive FrameTriggerWait AcquisitionTriggerWait UserOutput0 UserOutput1 FlashWindowActive ExternalTriggerActive
42		Line Debounce Time	IFloat	Read/Write	Guru	Input unit microseconds (μs)

		(Line1)				
43		User Output Value (Line2)	IBoolean	Read/Write	Expert	True False
44		User Output Value (Line3)	IBoolean	Read/Write	Expert	True False
45		User Output Value All	IInteger	Read/Write	Expert	0~3
46		User Output Value All Mask	IInteger	Read/Write	Expert	0~3

Configuration Process

Load user mode

1. Use User Set Selector to select the user mode to be loaded, e.g., User Set2.
2. Execute User Set Load and the camera will load the parameters in User Set2.

Save user mode

1. Load user set that would like to be saved, e.g., User Set2.
2. Configure the related parameters, such as Trigger Mode, Exposure Time, Gain, Black Level, Balance Ratio, Auto Function ROI, Gamma, and LUT.
3. Execute User Set Save and the camera will save the configured functions in User Set2.

Set to default mode

1. After selecting the default mode in User Set Default, the camera will directly load the user parameters after turning on in the future.

4.7 Auto Function

Provides users with ROI settings for auto exposure and auto balance white, and can be used to configure the detailed parameters of auto exposure.

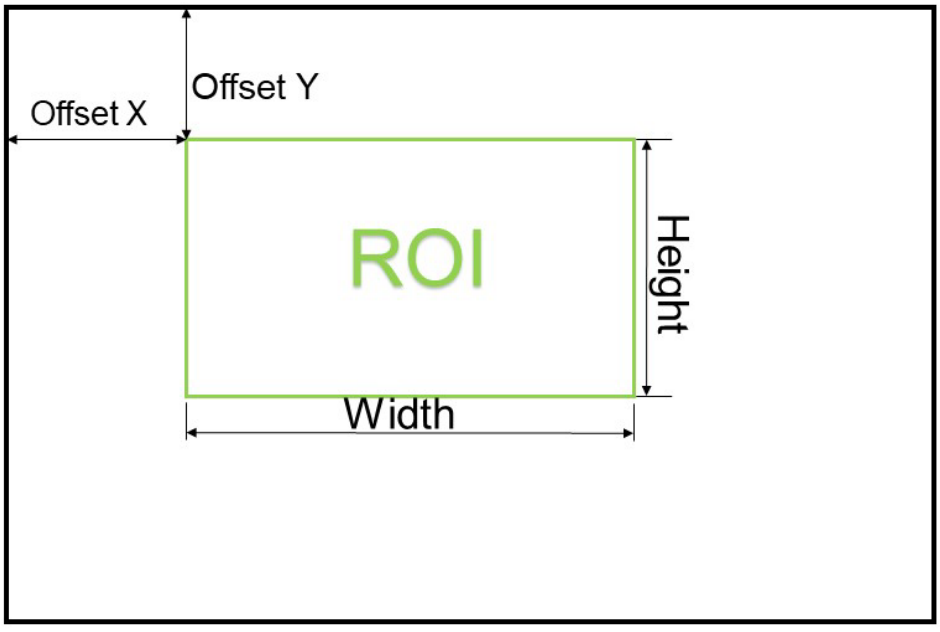
4.7.1 Auto function ROI function parameters

Serial No.	Name	Interface	Access	Parameter Level	Parameter Content
1	ROI Width	IInteger	Read/Write	Beginner	Device-specific
2	ROI Height	IInteger	Read/Write	Beginner	Device-specific
3	ROI Offset X	IInteger	Read/Write	Beginner	Device-specific
4	ROI Offset Y	IInteger	Read/Write	Beginner	Device-specific

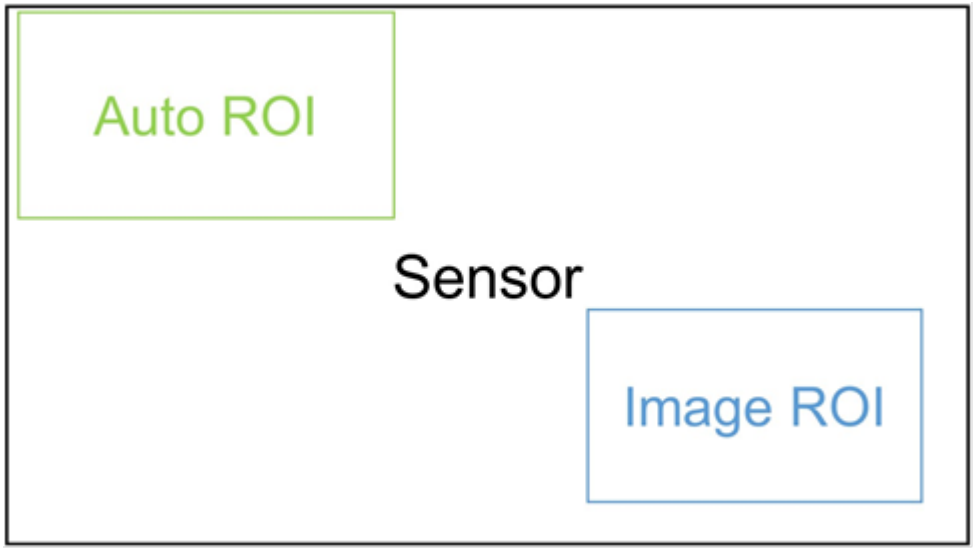
Description of Functions

1. ROI Width: Auto function ROI width setting.
2. ROI Height: Auto function ROI height setting
3. ROI Offset X: Auto function ROI x-axis origin.
4. ROI Offset X: Auto function ROI y-axis origin.

Auto function ROI Icon



Note: The ROI set by the auto function must be included in the camera ROI, so that the auto function can work normally.
The two ROIs in the figure below do not intersect with each other, and the auto function will not work properly at this time.



4.7.2 Auto exposure function parameters

Serial No.	Name	Interface	Access	Parameter Level	Parameter Content
1	Auto Current Intensity	IInteger	Read/Write	Beginner	Current value
2	Auto Target Intensity	IInteger	Read/Write	Beginner	32~255
3	Auto Exposure Time Min	IInteger	Read/Write	Beginner	20~800000
4	Auto Exposure Time Max	IInteger	Read/Write	Beginner	80~1000000

Description of Functions

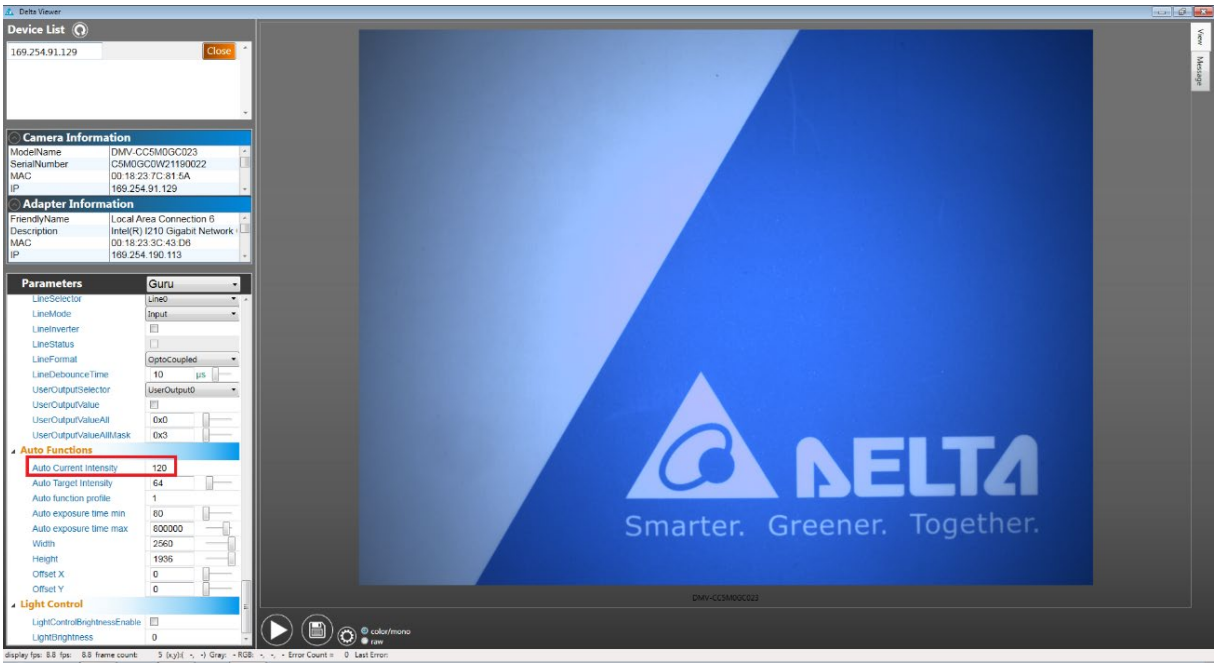
1. Auto Current Intensity: The average grayscale level of the current image.
2. Auto Target Intensity: Sets the target grayscale value after auto exposure.
3. Auto Exposure Time Min: The minimum auto exposure time. The default is 80μs.
4. Auto Exposure Time Max: The maximum auto exposure time. The default is 800000μs.

Configuration Process

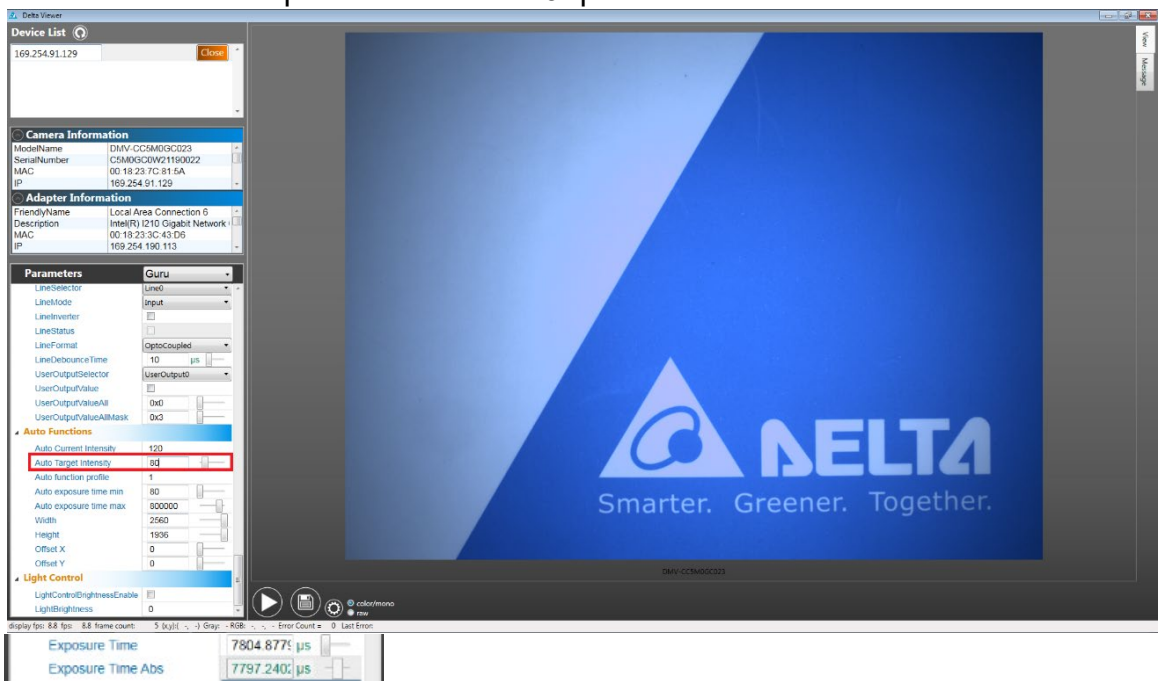
Auto Exposure

1. Check the Auto Current Intensity and confirm the current average grayscale value of the image.

   The value is 120 in the following example.

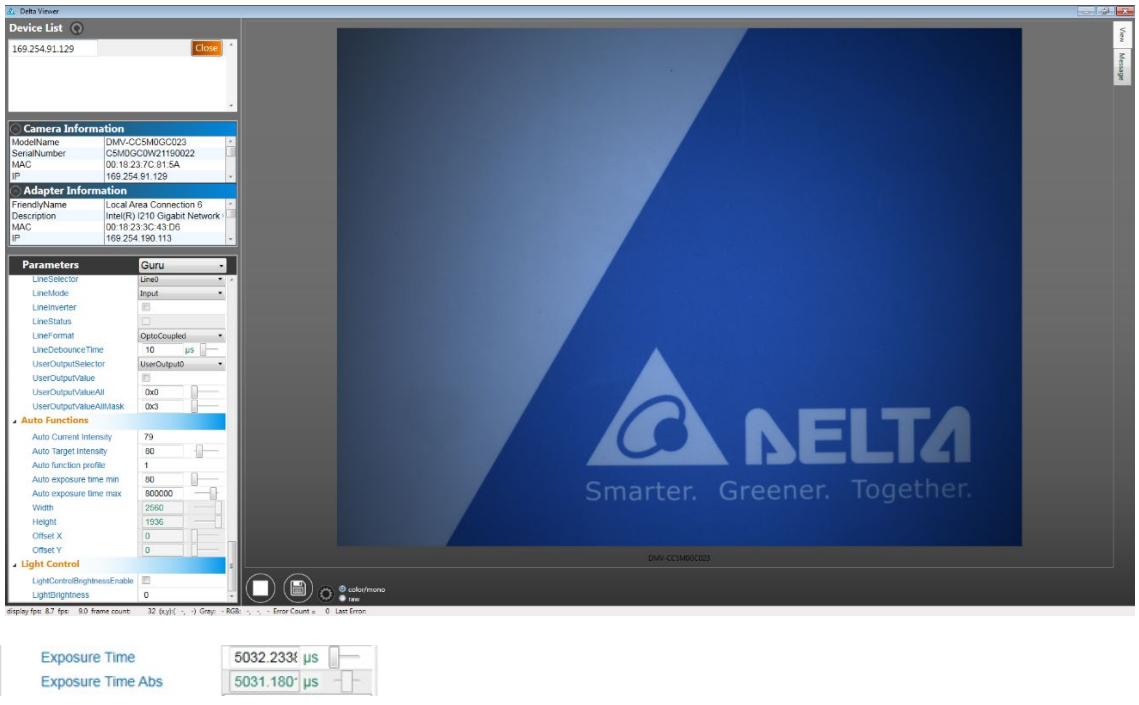


2. Set the Auto Target Intensity to set the target grayscale value after auto exposure. It is set to 80 and check if the current exposure value is 7797μs.



3. Set the ROI of the auto function and the Auto Exposure Time min/max. If there are no special requirements, the default values are recommended.
   Note: The ROI configured here is the ROI of the auto function. Do not set it as the camera ROI in Image Format Control.
4. Execute Exposure Auto. You can choose Once to perform auto exposure once or Continuous to continuously perform auto exposure. Once has been selected in the example. After execution, the exposure time has been automatically adjusted to 5032μs, and the Auto Current Intensity has been decreased to 79.

Note: After performing automatic exposure, the camera will adjust to the value set by Auto Target Intensity as much as possible, but the target value may not be fully reached. The difference between Auto Target Intensity and Auto Current Intensity is within about 5%.



4.8 Transport Layer Control

Provides users with function parameters related to network settings. The user can use the function parameters in this chapter to configure the IP mode, GVCP, GVSP, and other settings.

4.8.1 IP mode configuration function parameters

Serial No.	Name	Interface	Access	Parameter Level	Parameter Content
1	GEV Current IP Configuration LLA	IBoolean	Read /Write	Beginner	True
2	GEV Current IP Configuration DHCP	IBoolean	Read /Write	Beginner	True False
3	GEV Current IP Configuration Persistent IP	IBoolean	Read /Write	Beginner	True False
4	GEV Current IP Address	IInteger	Read	Beginner	xxx.xxx.xxxx.xxx
5	GEV Current Subnet Mask	IInteger	Read	Beginner	xxx.xxx.xxxx.xxx
6	GEV Current Default Gateway	IInteger	Read	Beginner	xxx.xxx.xxxx.xxx
7	GEV Persistent IP Address	IInteger	Read /Write	Beginner	xxx.xxx.x.x
8	GEV Persistent Subnet Mask	IInteger	Read /Write	Beginner	xxx.xxx.x.x
9	GEV Persistent Default Gateway	IInteger	Read /Write	Beginner	x.x.x.x

Description of Functions

1. GEV Current IP Configuration LLA: When LLA is enabled, the camera will automatically generate an IP. The range of the IP is from 169.254.0.1 to 169.254.255.254. This mode cannot be disabled.
2. GEV Current IP Configuration DHCP: Enables Dynamic Host Configuration Protocol (DHCP). When the camera detects a DHCP server, the DHCP server provides a set of IP and a subnet mask to the camera.
3. GEV Current IP Configuration Persistent IP: Enable persistent IP.
4. GEV Current IP Address: Display current IP.
5. GEV Current Subnet Mask: Display current subnet mask.
6. GEV Current Default Gateway: Display default gateway

7. GEV Persistent IP Address: To enter the persistent IP, the persistent IP mode has to be enabled.
8. GEV Persistent Subnet Mask: To enter the persistent subnet mask domain, the persistent IP mode has to be enabled.
9. GEV Persistent Default Gateway: To enter the persistent gateway, the persistent IP mode has to be enabled.

Configuration Process

Fixed IP Settings

1. Enter the persistent IP in “GEV Persistent IP Address", such as 192.168.1.5.
2. Enter the persistent subnet mask in “GEV Persistent Subnet Mask", such as 255.255.0.0.
3. Enable “GEV Current IP Configuration Persistent IP”.
4. When the power is turned off and the Ethernet cable is re-plugged in, the persistent IP mode will be enabled after reboot. The camera will use the persistent IP and network card for connection. Please confirm that the IP and subnet mask used by the network card matches the camera to ensure a normal connection.

4.8.2 Communication interface information function parameters

The host and application can read the following function parameters to check the information related to the communication interface.

Serial No.	Name	Interface	Access	Parameter Level	Parameter Content
1	GEV Link Speed	IInteger	Read	Expert	Internet speed
2	GEV MAC Address	IInteger	Read	Beginner	00：18：23：xx：xx：xx
3	GEV First URL	IString	Read	Guru	Local：DMVCM_GEV.zip;11000000;xxxx
4	GEV Second URL	IString	Read	Guru	NA
5	GEV Number of Interfaces	IInteger	Read	Expert	Device-specific
6	GEV Version Major	IInteger	Read	Expert	Device-specific
7	GEV Version Minor	IInteger	Read	Expert	Device-specific
8	GEV Device Mode is Big Endian	IBoolean	Read	Guru	True False
9	GEV Device Mode Character Set	IEnumeration	Read	Guru	UTF-8

Description of Functions

1. GEV Link Speed: Shows the connection speed of the camera (Mbps). The optimal speed is 1000Mbps.
2. GEV MAC Address: Displays the MAC address of the camera.
3. GEV First URL: Shows the URL of the first GenICam XML file of the camera. The application shall access the GenICam XML file according to the order of the URLs.
4. GEV Second URL: Shows the URL of the second GenICam XML file. The second XML file will act as the substitute when the first GenICam XML file cannot be accessed by the application. Only 1 GenICam XML file is provided by the camera currently.
5. GEV Number of Interfaces: Shows the number of network interfaces supported by the camera.
6. GEV Version Major: Shows the main version of the GigE Vision specifications of the camera, such as for GigE Vision version 2.0, the value shown will be 2.
7. GEV Version Minor: Shows the sub-version of the GigE Vision specifications of the camera, such as for GigE Vision version 2.0, the value shown will be 0.
8. GEV Device Mode is Big Endian: Shows whether the current register bit order of the camera is high-order bits first. The bit order of the DMV-C camera register is high-order bits first.
9. GEV Device Mode Character Set: Shows the font used by all text in the camera. The internal font format of the DMV-C camera is UTF-8.

4.8.3 GVCP (GigE Vision Control Protocol) function parameters

The GigE Vision protocol mainly regulates the control settings and status confirmation of the camera functions by the host and the application.

Serial No.	Name	Interface	Access	Parameter Level	Parameter Content
1	GEV Heartbeat Timeout	IInteger	Read /Write	Guru	500~10000
2	GEV Heartbeat Disable	IBoolean	Read /Write	Expert	True False
3	Gev GVCP Pending Timeout	IInteger	Read	Guru	2000
4	GEV Pending Acknowledge Enable	IBoolean	Read /Write	Guru	True False
5	GEV CCP	IEnumeration	Read /Write	Guru	Open Access Exclusive Access Control Access
6	GEV Primary Application Socket	IInteger	Read	Guru	xxxxx
7	GEV Primary Application IP Address	IInteger	Read	Guru	169.254.xxx.xxx
8	GEV SCBWR	IInteger	Read /Write	Guru	1

Description of Functions

1. GEV Heartbeat Timeout: Enters the heartbeat timeout time with milliseconds (ms) as the unit. The default is 500.
2. GEV Heartbeat Disable: Disables the heartbeat function. The default is False to enable the heartbeat function and True to disable the function.
3. Gev GVCP Pending Timeout: Shows the longest GVCP instruction execution time, which is 2000 milliseconds (ms).
4. GEV Pending Acknowledge Enable: Enables delay notifications. The longest GVCP instruction execution time is set to 2000 milliseconds. When the command to execute GVCP exceeds the expected time, the delay notification will be sent to notify the application that the current command has exceeded the expected time. The application can then adjust the pending time according to the notification.

5. GEV CCP: Control Channel Privilege. When the usage setting involves multiple applications connected to the same DMV-C camera, only one application can write and control the DMV-C camera. The other applications can only read the camera parameters.
   Open Access: When a camera is not controlled by any application, it will show Open Access.
   Exclusive Access: When the parameters of a camera can only be written or read by one application, the other applications cannot perform any actions.
   Control Access: The parameters of a camera can only be written and read by a single application. The other applications can only read the camera parameters.
6. GEV Primary Application Socket: Shows the UDP source port of the main application.
7. GEV Primary Application IP Address: Shows the IP address of the main application.
8. GEV SCBWR: Stream channel bandwidth reserved. This function can be configured to reserve the bandwidth for the streaming channel.

4.8.4 GVSP (GigE Vision Streaming Protocol) function parameters

The GigE Vision streaming protocol mainly regulates the transmission of images from the camera to the host and applications.

Serial No.	Name	Interface	Access	Parameter Level	Parameter Content
1	Payload Size	IInteger	Read	Expert	Device-specific
2	GEV Stream Channel Count	IInteger	Read	Expert	1
3	GEV Stream Channel Selector	IInteger	Read/Write	Expert	0
4	GEV SCP Direction	IEnumeration	Read	Guru	Transmitter Receive
5	GEV Interface Selector	IInteger	Read/Write	Beginner	0
6	GEV SCP Interface Index	IInteger	Read/Write	Guru	0
7	GEV SCP Host Port	IInteger	Read/Write	Guru	xxxxx
8	GEV SCPS Fire Test Packet	IBoolean	Read/Write	Guru	True False
9	GEV SCPS Do Not Fragment	IBoolean	Read/Write	Guru	True False
10	GEV SCPS Big Endian	IBoolean	Read/Write	Guru	True False
11	GEV SCPS Packet Size	IInteger	Read/Write	Expert	Device-specific
12	GEV SCPD	IInteger	Read/Write	Expert	xx
13	GEV SCDA	IInteger	Read/Write	Guru	169.254.xxx.xxxx
14	GEV SCSP	IInteger	Read	Guru	xxxxx

Description of Functions

1. Payload Size: Transfer load size. It shows the number of bytes of each data transmission. The user can use this function to confirm the size of a single transmission, so that the application can know the required buffer space for the transmission. The general load formula is Height * Width * Pixel size. For example, the resolution of the DMV-CC5M camera is 2560*1936, so the load size is 2560 * 1936 * 8 bits/pixel / 8 bits/byte = 4956160 bytes. However, the load size data may be affected by adjustments to other function parameters. Therefore, the user should use this function to directly read the transmission load size.
2. GEV Stream Channel Count: Shows the number of streaming channels of the camera. Streaming channels allow the transmission of image data between the camera and host. The

default value is 1.

3. GEV Stream Channel Selector: Select the streaming channel to be controlled. The parameter is only 0.
4. GEV SCP Direction: After selecting the streaming channel, the function will show the direction of the camera streaming channel. Transmitter means the data is being transferred from the camera to the application, and only Transmitter is supported.
5. GEV Interface Selector: Logical link switch, and the DMV-C camera only provides 0 to be selected.
6. GEV SCP Interface Index: Shows the index value of the logical link, with only value 0.
7. GEV SCP Host Port: Shows the main port of the streaming channel.
8. GEV SCPS Fire Test Packet: Sends a test packet. After clicking the function, the camera will send a test packet. GEV SCPS Do Not Fragment needs to be enabled to use this function.
9. GEV SCPS Do Not Fragment: Enables the IP non-fragmentation function.
10. GEV SCPS Big Endian: Controls the bit order of the streaming channel. The default is False, low-order bits first.
11. GEV SCPS Packet Size: Defines the packet size of the streaming channel. The unit is byte.
12. GEV SCPD: The delay time for embedding each packet within the control stream channel.
13. GEV SCDA: Configures the target IP address for images transmitted from the camera.
14. GEV SCSP: Shows the source port of the streaming channel.

4.8.5 Other communication interface information function parameters

Other settings related to the communication interfaces.

Serial No.	Name	Interface	Access	Parameter Level	Parameter Content
1	GEV Supported Option Selector	IEnumeration	Read /Write	Expert	Commands Concatenation User Defined Name Serial Number Heartbeat Disable Link Speed Test Data Extended Status Codes Pending Ack Event Data Event Packet Resend Write Mem IPConfiguration LLA IPConfiguration DHCP IPConfiguration Persistent IP Stream Channel Source Socket CCP Application Socket Manifest Table Discovery Ack Delay Discovery Ack Delay Writable Action
2	GEV Supported Option	IBoolean	Read	Expert	True False
3	GEV Message Channel Count	IInteger	Read	Invisible	0

Description of Functions

1. GEV Supported Option Selector: Confirmation of support for communication functions. The user can check the GEV Supported Option after selecting specific functions to confirm whether the camera supports the selected function. Descriptions of the supported functions are as follows.

- User Defined Name: 4.1.1 Device User ID, customizes the name of the camera.
- Serial Number: 4.1.1 Device Serial Number, displays the camera serial number.
- Heartbeat Disable: 4.8.3 GEV Heartbeat Disable, disables the heartbeat function.
- Link Speed: 4.8.2 GEV Link Speed, displays the transfer speed of the camera (Mbps).
- Pending Ack: 4.8.3 GEV Pending Acknowledge Enable, enables delay notification.
- IPConfiguration LLA: 4.8.1 GEV Current IP Configuration LLA, enables LLA link local address mode.
- IPConfiguration DHCP: 4.8.1 GEV Current IP Configuration DHCP, enables Dynamic Host Configuration Protocol (DHCP).
- IPConfiguration Persistent IP: 4.8.1 GEV Current IP Configuration Persistent IP, enables persistent IP.

2. GEV Supported Option: The function will display True or False in response to the GEV Supported Option Selector. If True, it means the function is supported, and if False, it means it is not supported.
3. GEV Message Channel Count: Displays the number of message channels for the camera. The camera can use the message channels to transmit messages to the console. This value is 0 for the DMV-C camera.

Appendix

Appendix

A.1 DMV-SDK Quick Start

This section will quickly guide user to use DMV-SDK which can control DMV-C camera and access all camera's parameters. DMV-SDK offers API for two languages including .NET and C. Regarding to DMC-SDK installation procedure, please refer to chapter 2.7 for more details.

DMV-SDK provides a bunch of sample codes for various common scenarios. Those sample codes are located on the below paths:

C#/VB.NET:
C:\Program Files\Delta Industrial Automation\DIAVision\DMV-SDK\Development\.NET\Sample

C:
C:\Program Files\Delta Industrial Automation\DIAVision\DMV-SDK\Development\C\sample

The following article will demonstrate how to set up a C# project for .NET Framework or .NET Core step by step on Visual studio 2019, and execute a set of DMV-SDK's sample code. For more information about .NET API, please refer to API's chm file under the folder of DMV-SDK.

A.1.1 Create a C# .NET Framework Project

Development environment:

- Visual Studio 2019
- .NET Framework 4.7.2

Step to create a .NET Framework Project:

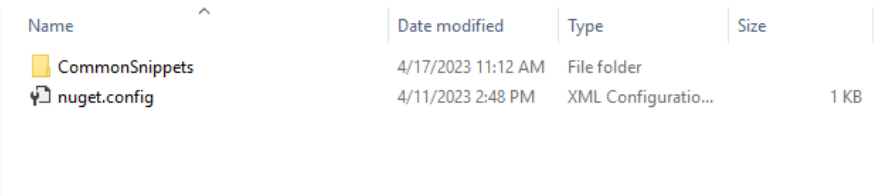
1. Create a new folder and name it as you prefer. In this instruction, we will create a folder called QuickStart_Framework. C# project and other relevant files will be put in this folder later.

2. Copy below two items to the folder that we created in step1.

- nuget.config file:
  Including a package of DMV-SDK .NET API. With nuget.config file, user can simply install the package of DMV-SDK. .NET API and dependencies will automatically download and install to the C# project.
  Path: C:\Program Files\Delta Industrial Automation\DIAVision\DMV-SDK\Development\.NET\Nuget

- Common Snippets:
  Including several reusable codes of common methods such as
  - Search for the first camera on the system
  - Print general information of the camera
  - Disable all trigger mode
  - Set up exposure time
  - Save image

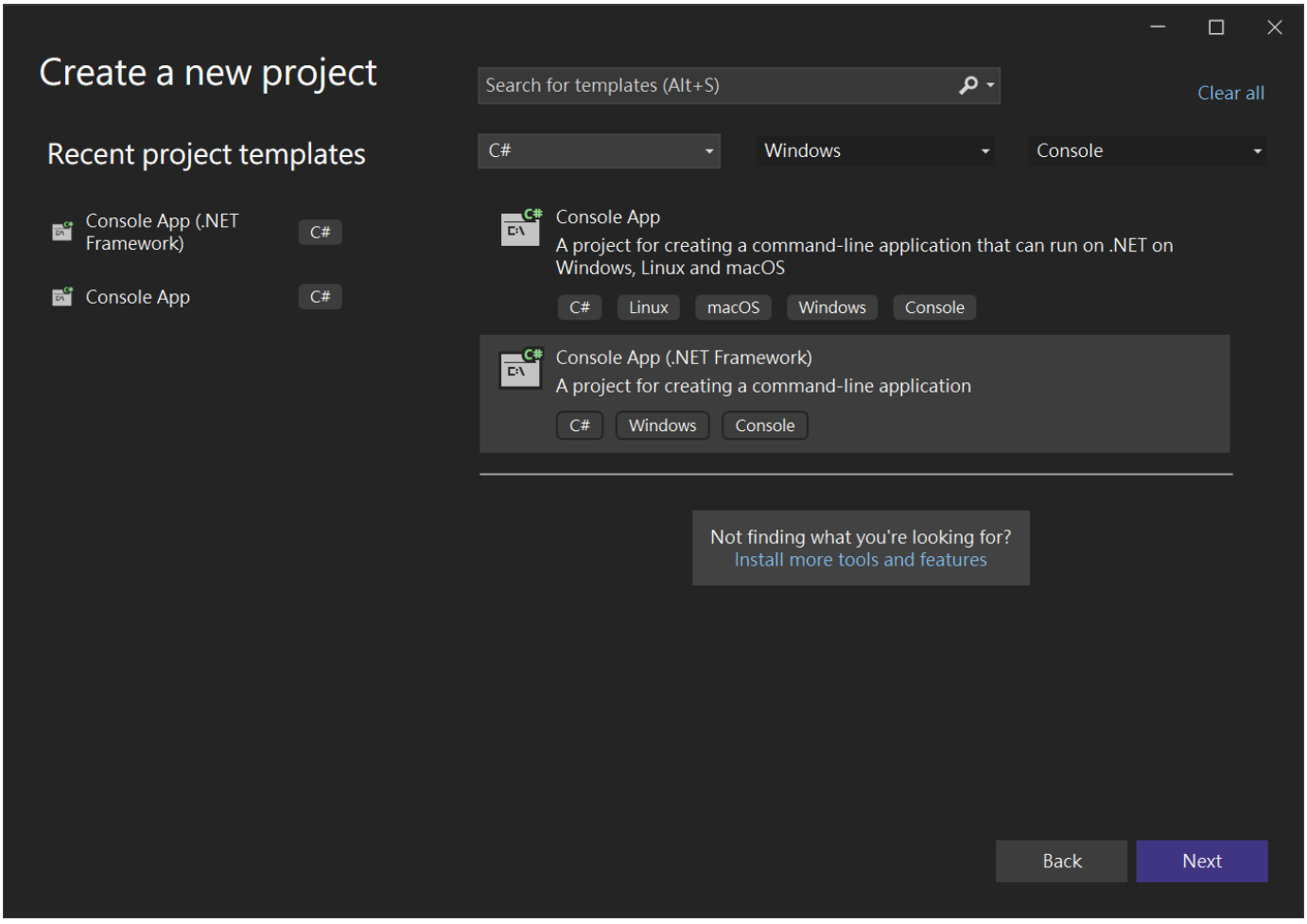
  Path: C:\Program Files\Delta Industrial Automation\DIAVision\DMV-SDK\Development\.NET\Sample\CS

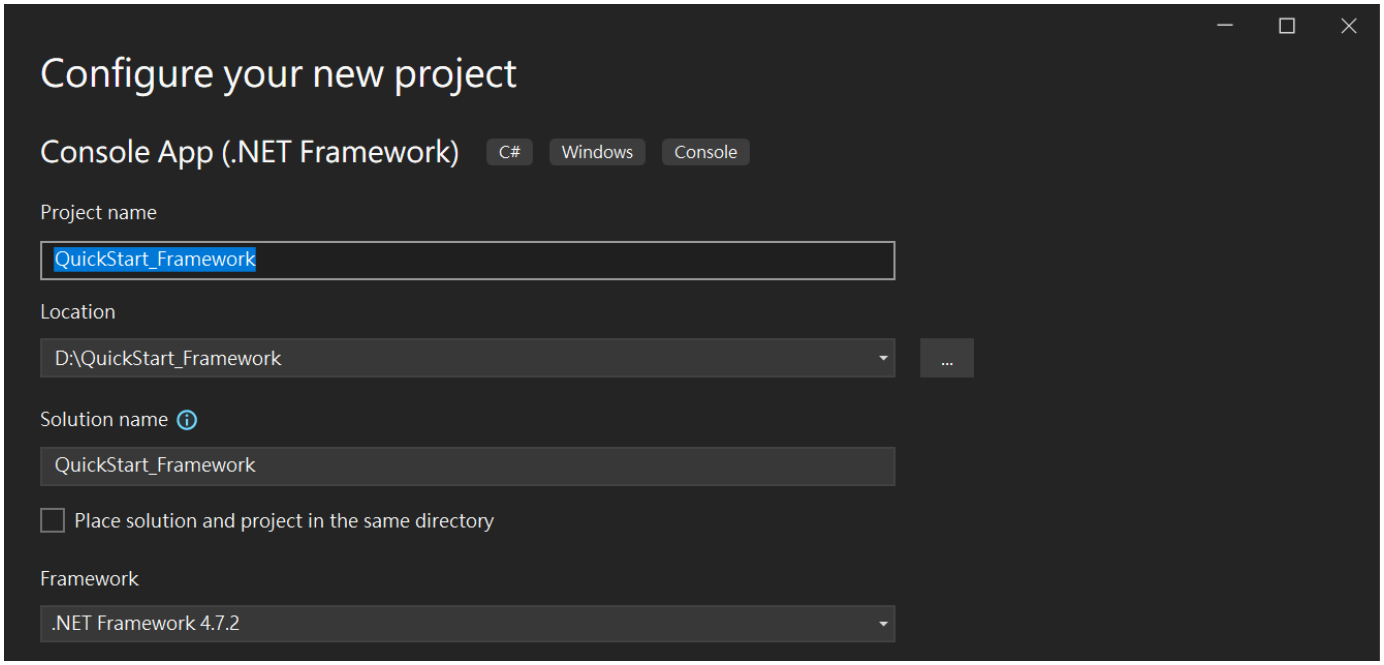


3. Create a console App(.NET Framework).

- Project Name: QuickStart_Framework
- Location: Folder created in step1
- Solution Name: QuickStart_Framework
- Framework: .NET Framework4.7.2

Note: DMV-SDK .NET API follows specification of .NET Standard 2.0 which currently is supporting the following .NET versions:
.NET Framework version: 4.6.1, 4.6.2, 4.7, 4.7.1, 4.7.2, 4.8, 4.8.1
.NET & .NET Core version: 2.0, 2.1, 2.2, 3.0, 3.1, 5.0, 6.0, 7.0



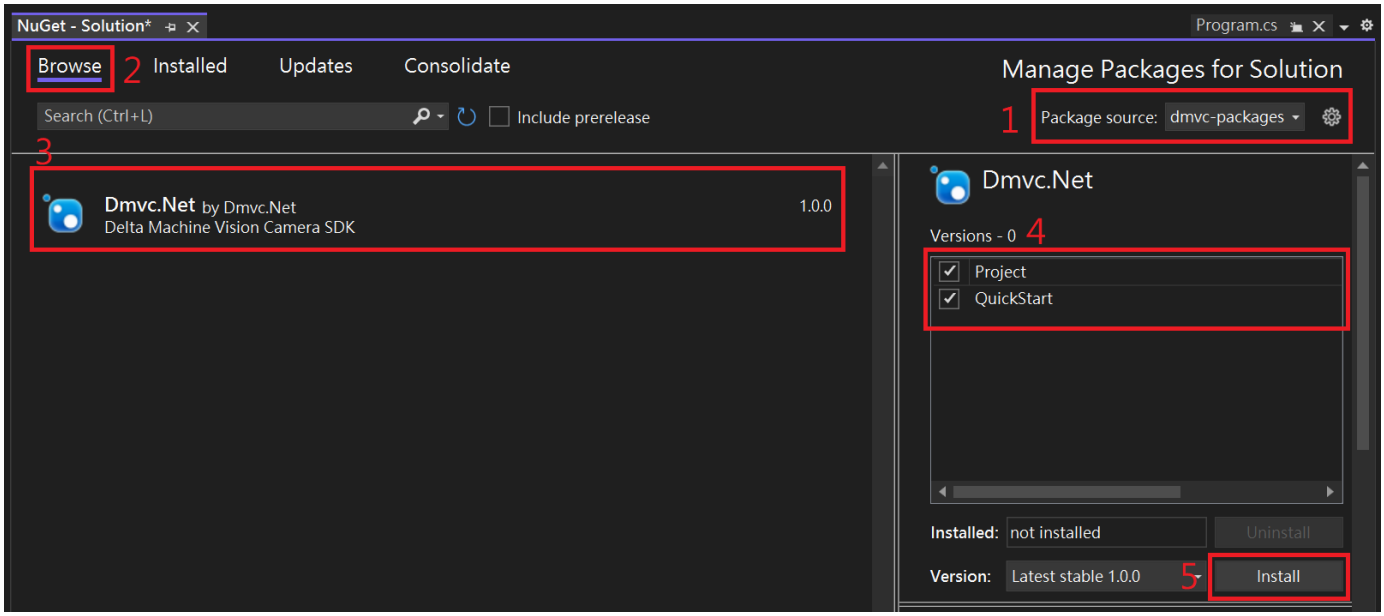


4. Follow below steps to install NuGet package

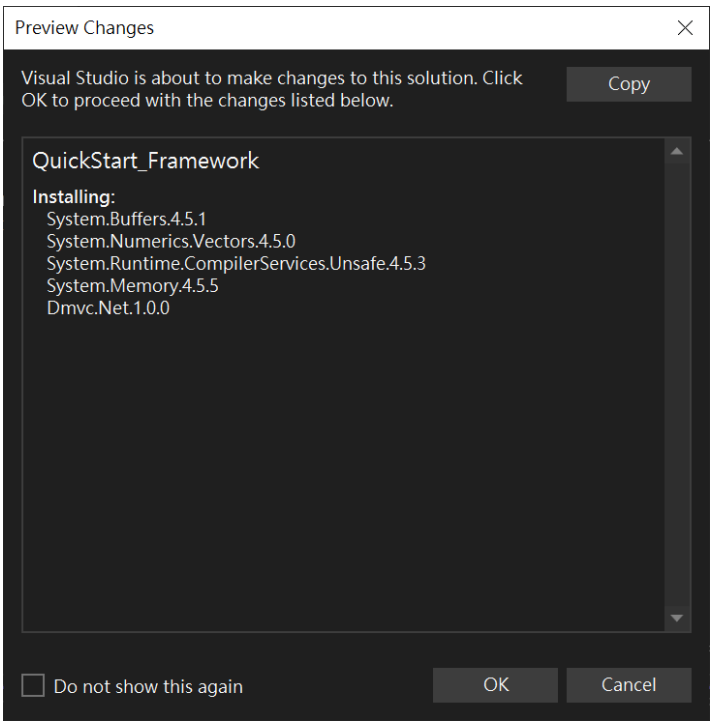
- Visual studio->Tool->NuGet Package Manager->Manage NuGet Packages for Solution
- Select either dmvc-packages or all as Package source
- Click browse

Note: dmvc-pacakges will not show on Package source if nuget.config file is not in the QuickStart folder. If you copy nuget.config to the folder later, please reopen Visual studio and dmvc-pacakges will show up.

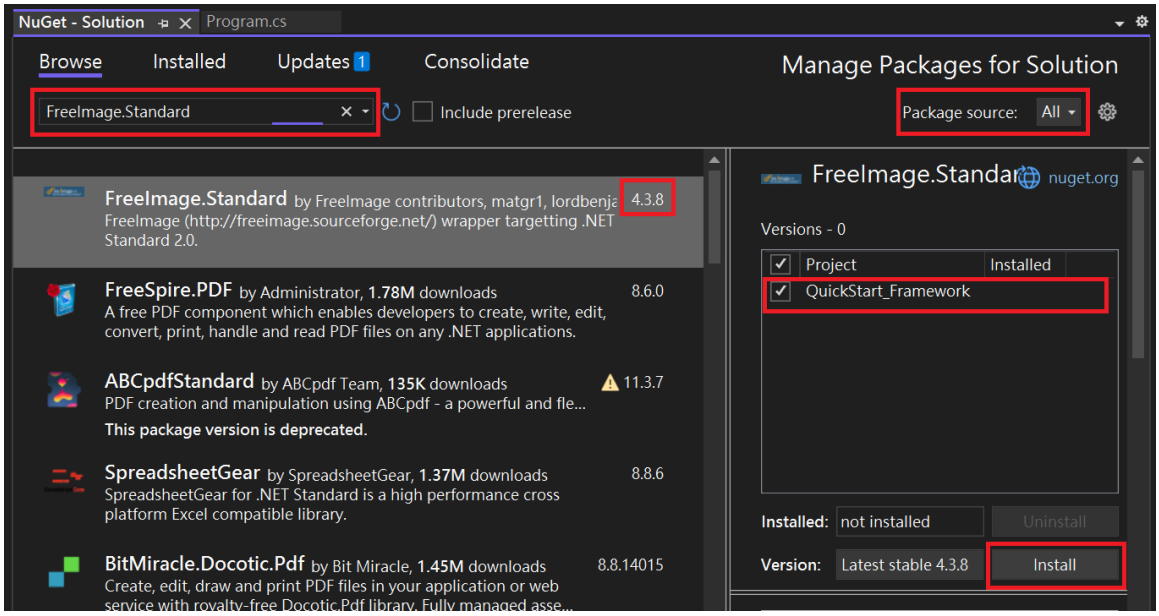
- Click Dmvc.Net
- Select which Project will be installed
- Click Install



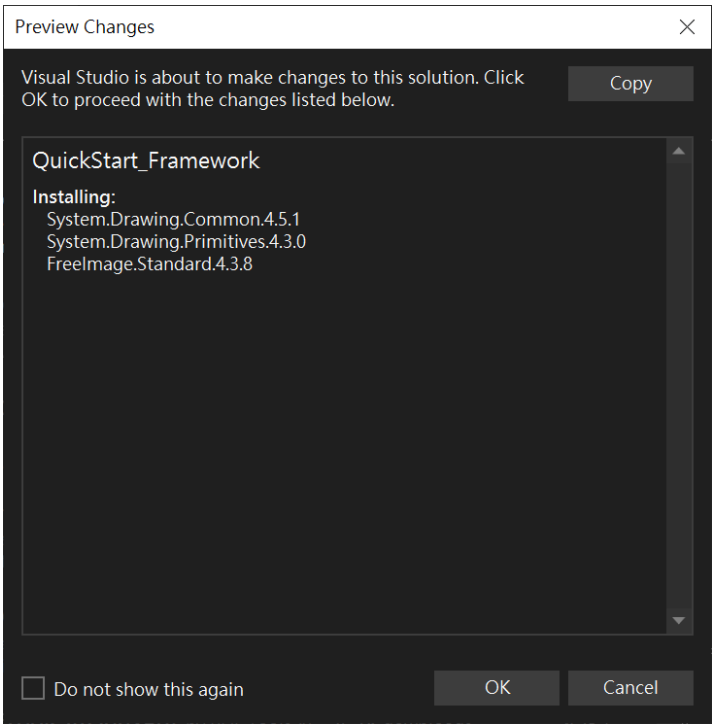
- Click OK and proceed to install NuGet after the following message popping up



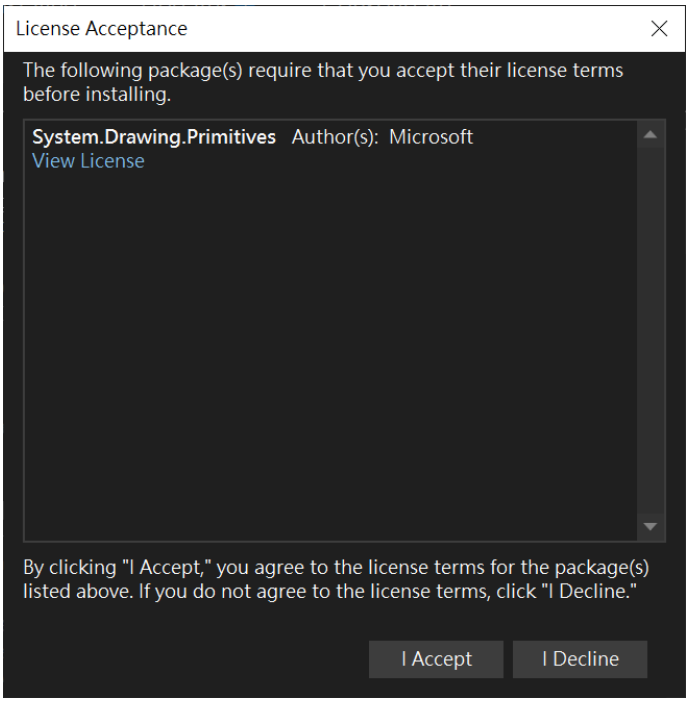
5. Install 3rd party nuget pacakage for function of saving image.
   - Visual studio->Tool->NuGet Package Manager->Manage NuGet Packages for Solution
   - Select all as Package source
   - Search for FreeImage.Standard, and find FreeImage.Standard 4.3.8
   - Select which project will need to install FreeImage.Standard
   - Click Install



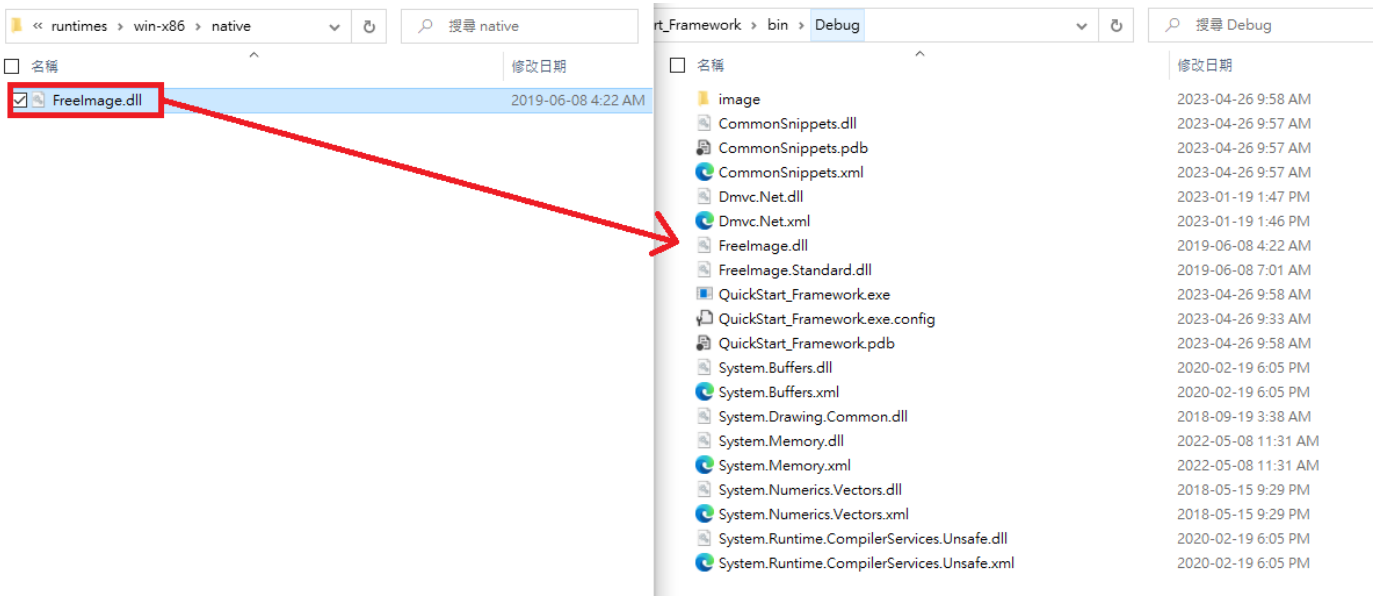
- Click OK and proceed to install NuGet after the following message popping up



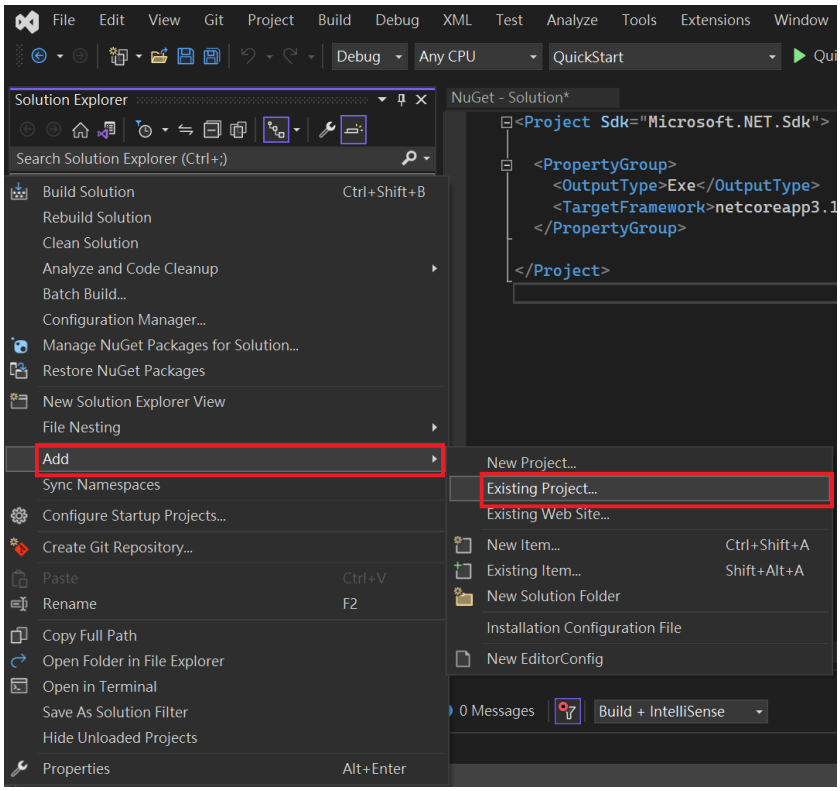
- Click OK and proceed to install NuGet after the following message popping up

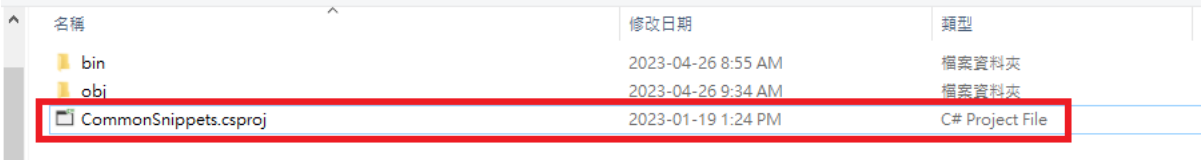


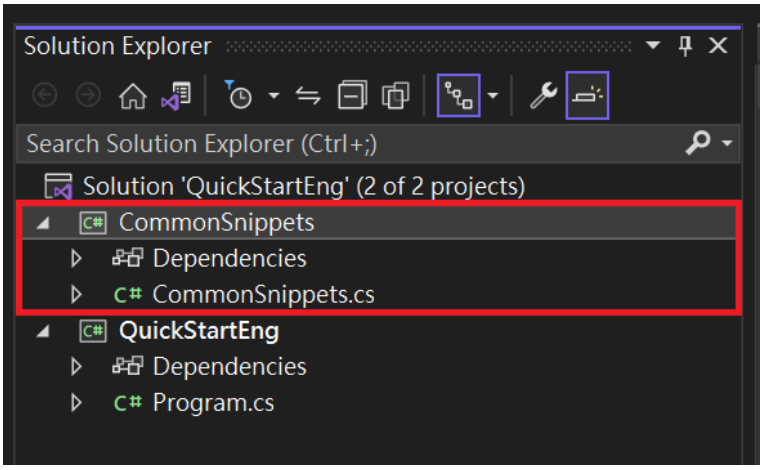
- After building the project, please manually copy FreeImage.dll to the folder of Debug.
  FreeImage.dll path:
  D:\QuickStart_Framework\QuickStart_Framework\packages\FreeImage.Standard.4.3.8\runtimes\win-x86\native



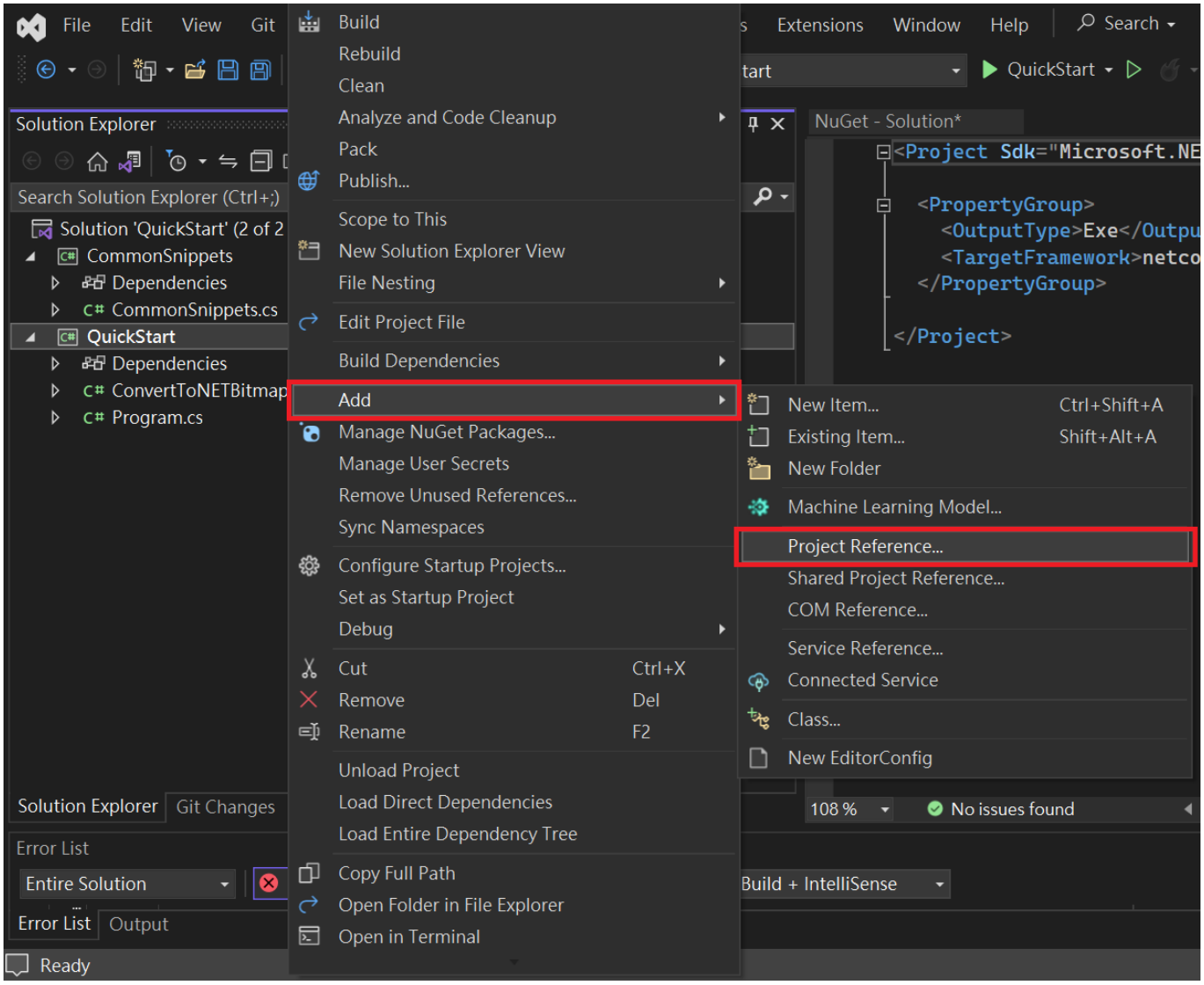
6. Add CommonSnippets.csproj in the Solution so that the project of QuickStart can call methods from Common Snippets.

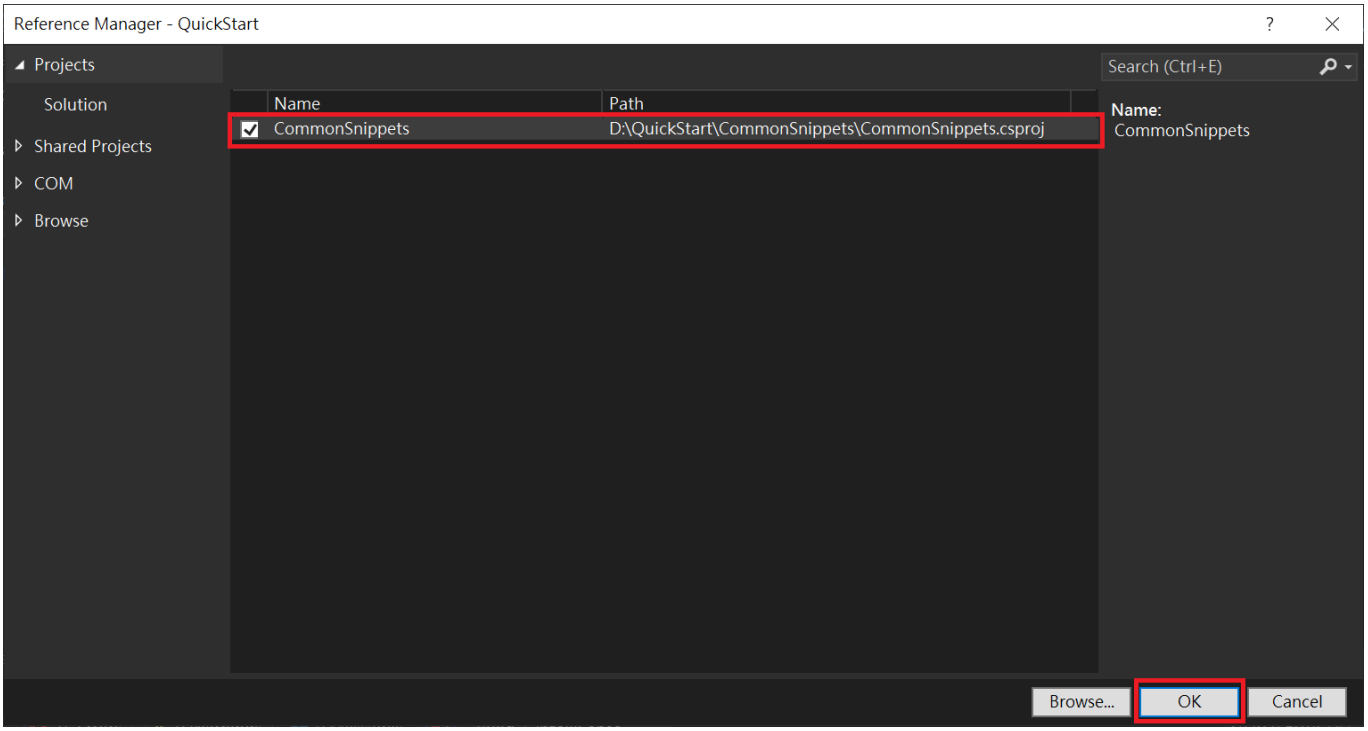






- Manually reference the project of Common Snippets





7. Please refer to A.1.3 for section of sample code.

A.1.2 Create a C# .NET Core Project

Development environment:

- Visual Studio 2019
- .NET Core 3.1

Step to create a .NET Core Project:

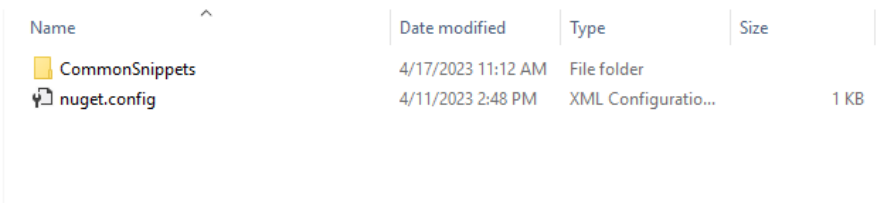
1. Create a new folder and name it as you prefer. In this instruction, we will create a folder called QuickStart. C# project and other relevant files will be put in this folder later.

2. Copy below two items to the folder that we created in step1.

- nuget.config file:
  Including a package of DMV-SDK .NET API. With nuget.config file, user can simply install the package of DMV-SDK .NET API and dependencies will automatically download and install to C# project.
  Path: C:\Program Files\Delta Industrial Automation\DIAVision\DMV-SDK\Development\.NET\Nuget

- Common Snippets:
  Including several reusable codes of common methods such as
  - Search for the first camera on the system
  - Print general information of the camera
  - Disable all trigger mode
  - Set up exposure time
  - Save image

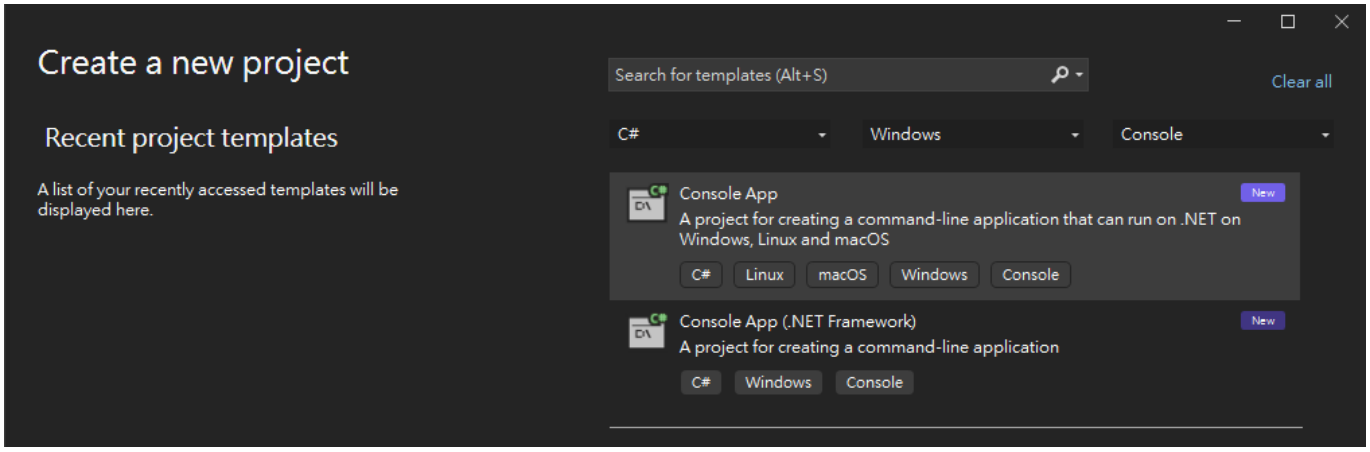
  Path: C:\Program Files\Delta Industrial Automation\DIAVision\DMV-SDK\Development\.NET\Sample\CS

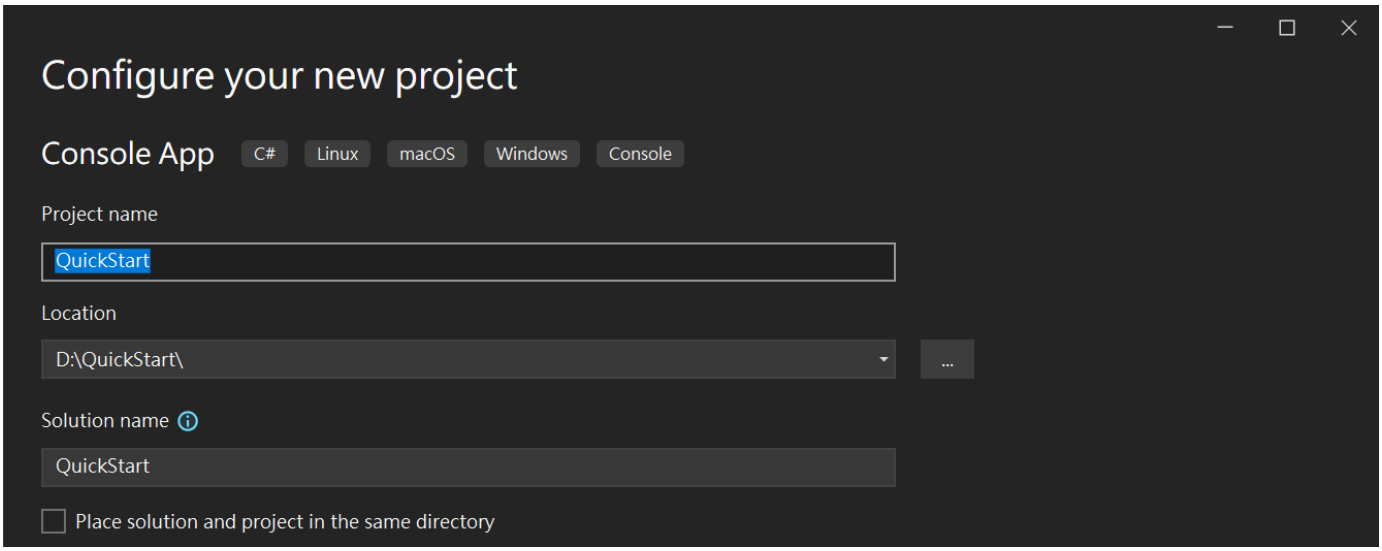


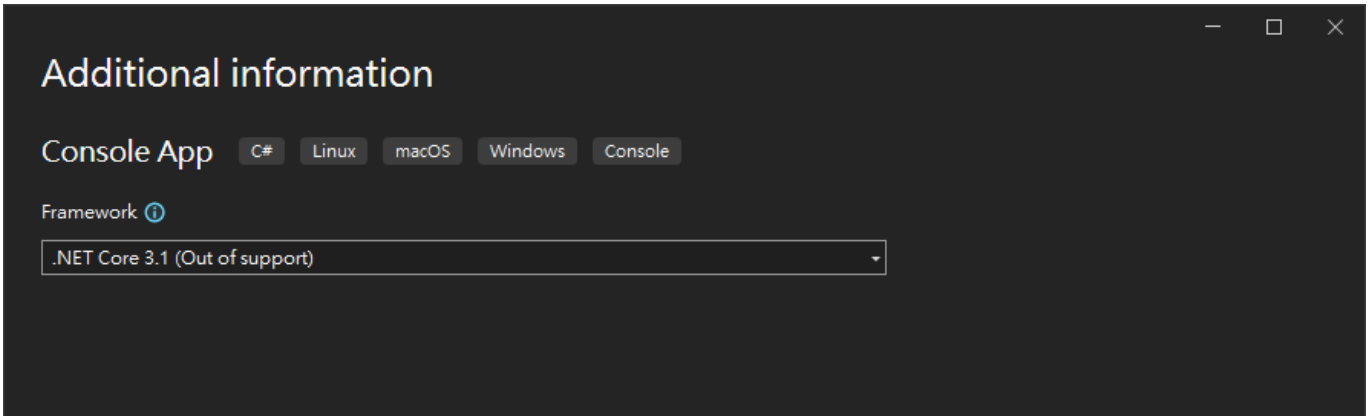
3. Create a console App.

- Project Name: QuickStart
- Location: Folder created in step1
- Solution Name: QuickStart
- Framework: .NET Core 3.1

Note: DMV-SDK .NET API follows specification of .NET Standard 2.0 which currently is supporting the following .NET versions:
.NET & .NET Core version: 2.0, 2.1, 2.2, 3.0, 3.1, 5.0, 6.0, 7.0
.NET Framework version: 4.6.1, 4.6.2, 4.7, 4.7.1, 4.7.2, 4.8, 4.8.1





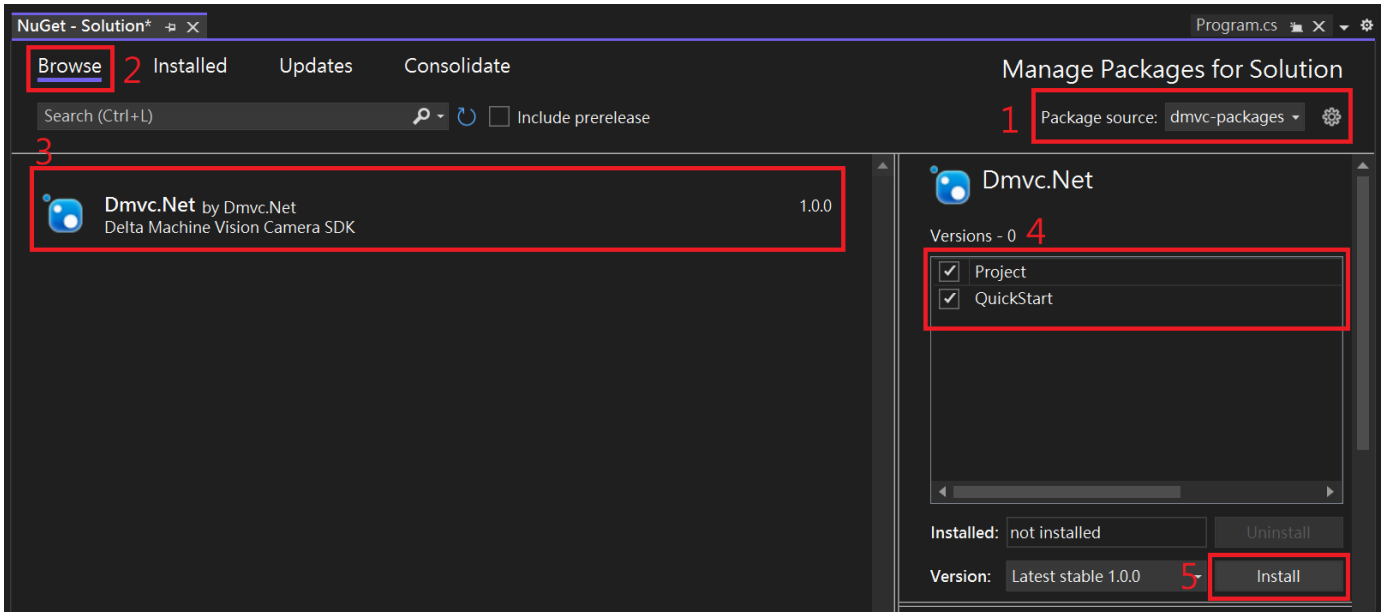


4. Follow below steps to install NuGet package

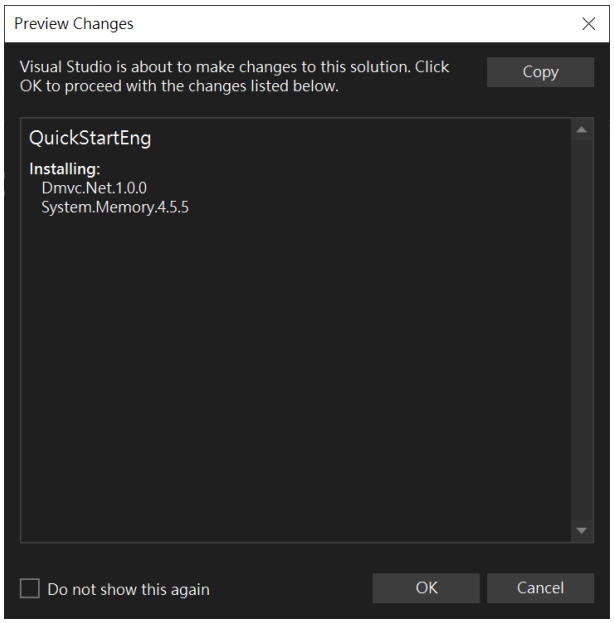
- Visual studio->Tool->NuGet Package Manager->Manage NuGet Packages for Solution
- Select either dmvc-packages or all as Package source
- Click browse

Note: dmvc-pacakges will not show on Package source if nuget.config file is not in the QuickStart folder. If you copy nuget.config to the folder later, please reopen Visual studio and dmvc-pacakges will show up.

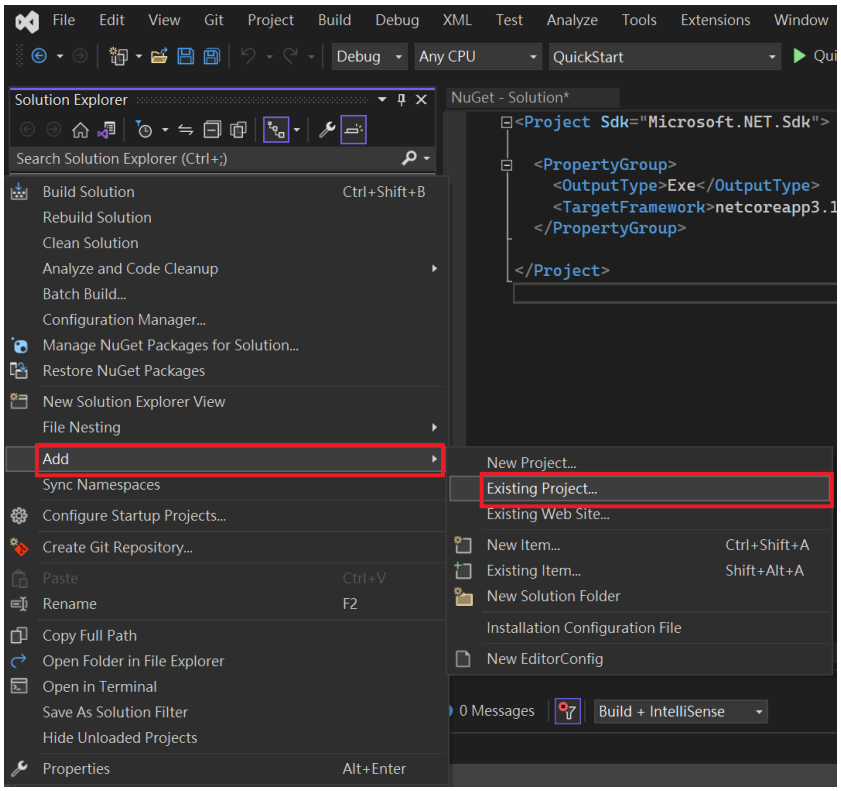
- Click Dmvc.Net
- Select which Project will be installed
- Click Install

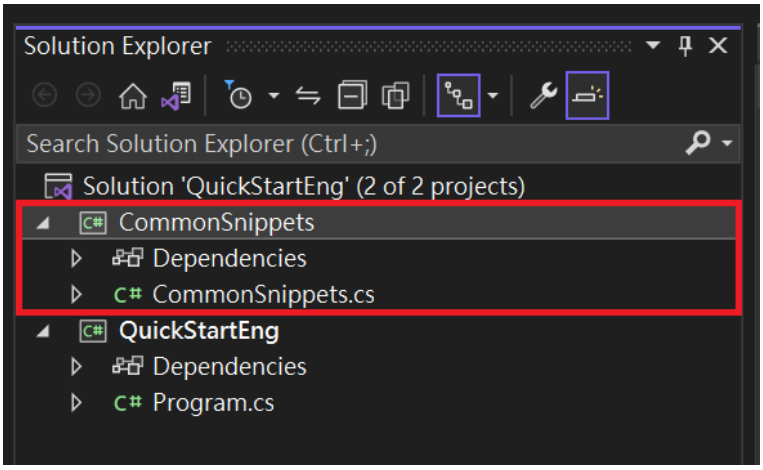


- Click OK and proceed to install NuGet after the following message popping up

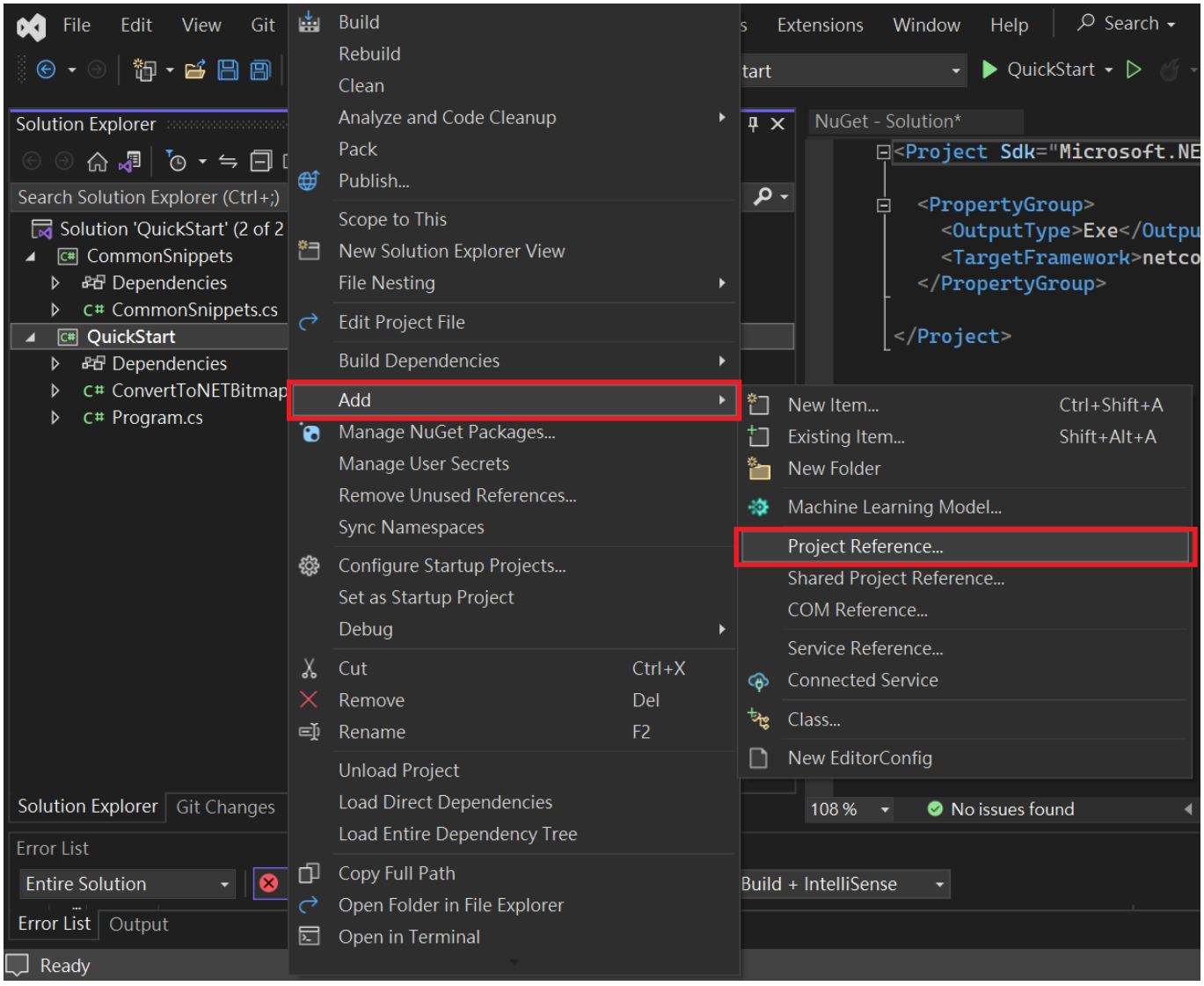


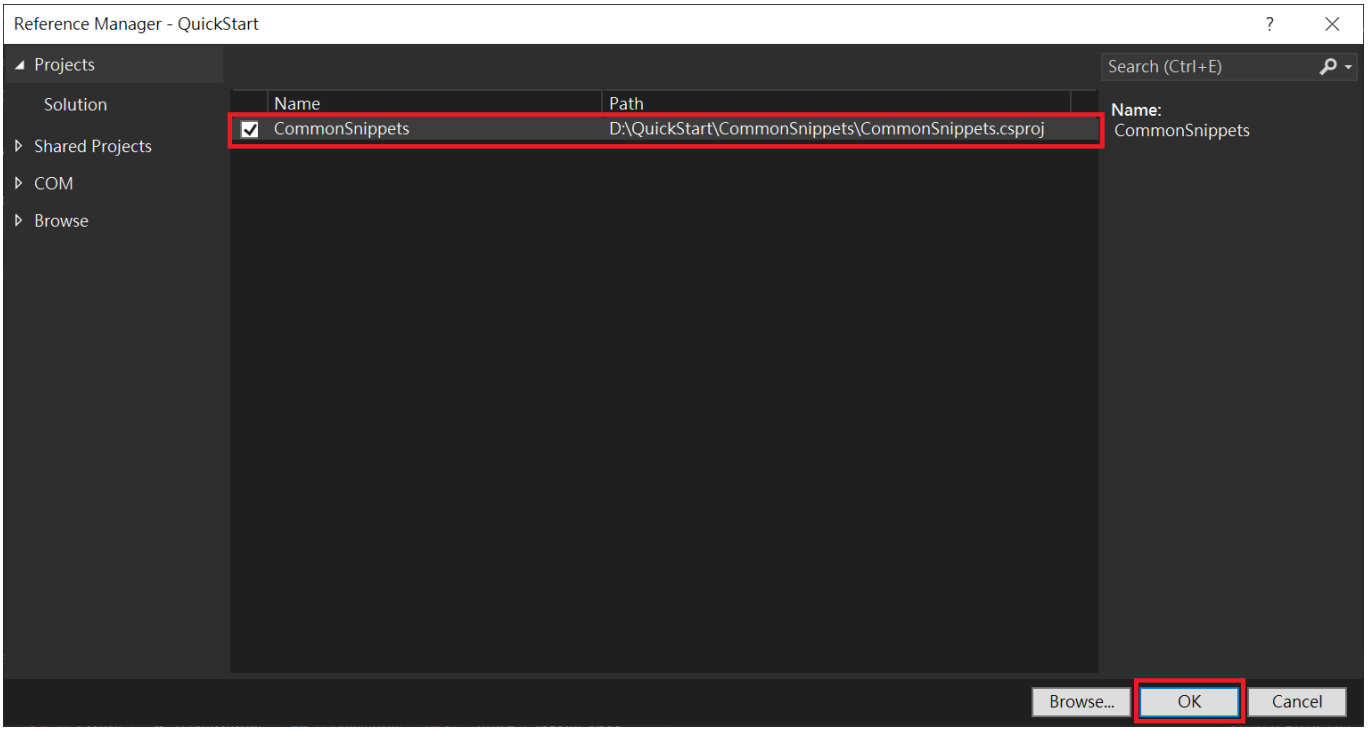
5. Add CommonSnippets.csproj in Solution 'QuickStart' so that the project of QuickStart can call methods from Common Snippets.





- Manually reference the project of Common Snippets.





6. Please refer to A.1.3 for section of sample code.

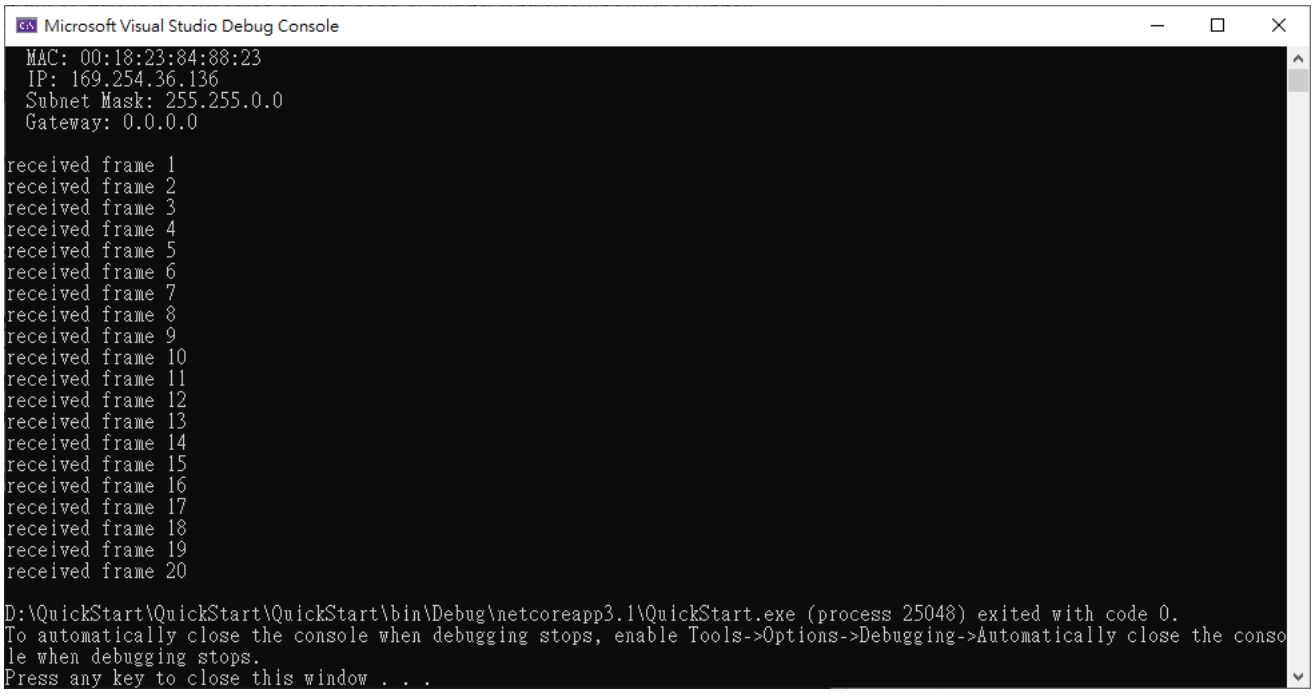
A.1.3 Sample code

The project of QuickStart executes sample code of ImageAcquisition.SoftwareTrigger.
Path: C:\Program Files\Delta Industrial Automation\DIAVision\DMV-SDK\Development\.NET\Sample\CS

The sample code shows how to capture images and process receiving images. Furthermore, it demonstrates the way to configure the camera as continuous mode and enable only FrameStart trigger. As a result, each trigger captures a single image after camera starts acquisition.

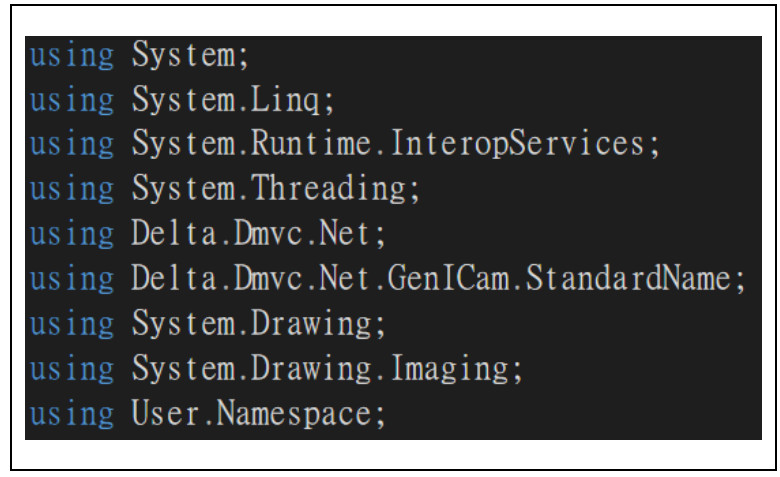
Note: QuickStart captures monochromatic image as default. If you would like to capture colorful image, please refer to A.1.4 for more information.

You may need to copy all codes from ImageAcquisition.SoftwareTrigger to QuickStart and run the program to see how it works. The sample will capture 20 images each run and save them to the folder of debug as default.
Next section will explain the content of the sample code.



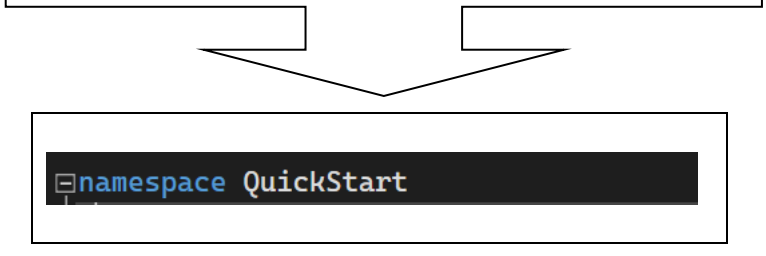
- Declare Namespace

```
using Delta.Dmvc.Net;
using Delta.Dmvc.Net.GenICam.StandardName;
using System;
using System.Drawing;
using System.Drawing.Imaging;
using System.Linq;
using System.Runtime.InteropServices;
using System.Threading;
using User.Namespace;
```



```
using System;
using System.Linq;
using System.Runtime.InteropServices;
using System.Threading;
using Delta.Dmvc.Net;
using Delta.Dmvc.Net.GenICam.StandardName;
using System.Drawing;
using System.Drawing.Imaging;
using User.Namespace;
```

```
namespace QuickStart
```



```
namespace QuickStart
```

- Call methods from Common Snippets:

1. Return the first camera on the system
2. Open camera
3. Print information about camera on console
4. Disable all trigger mode

C#

```
// Enumerates all cameras on the system and return the first available one, if exist.
// See CommonSnippets/Program.cs for detail steps.
var device = Snippets.GetFirstDevice((d) => d.AccessStatus == DeviceAccessStatus.ReadWrite);
if (device == null)
{
    Console.WriteLine("No available device found");
    return;
}

// Opens the connection to the camera.
device.Open(DeviceAccessType.Control);

// Prints the model name, MAC and IP information of the device.
// See CommonSnippets/Program.cs for detail steps.
Snippets.PrintDeviceInfo(device);

// Disables all trigger mode the camera provided.
// See CommonSnippets/Program.cs for detail steps.
Snippets.DisableAllTrigger(device);
```

- Configure parameters of the camera:

Trigger Selector: Frame Start
Trigger Mode: On
Trigger Source: Software
Acquisition Status Selector: Frame Trigger Wait
Acquisition Mode: Continuous

C#

```
// Set TriggerSelector as FrameStart, to edit FrameStart trigger properties
device.RemoteNodes[Remote.TriggerSelector].Value = "FrameStart";

// Enable the FrameStart trigger.
device.RemoteNodes[Remote.TriggerMode].Value = "On";

// Use Software command as trigger source.
device.RemoteNodes[Remote.TriggerSource].Value = "Software";

// Select to watch FrameTriggerWait status.
device.RemoteNodes[Remote.AcquisitionStatusSelector].Value = "FrameTriggerWait";

// Sets AcquisitionMode as Continuous so that the camera is going to free run
device.RemoteNodes[Remote.AcquisitionMode].Value = "Continuous";
```

- Set up location of saving image:

C#

```
// Prepares a destination directory to store images.
System.IO.Directory.CreateDirectory("image");
```

- Set up events for receiving images including creating an auto reset event to notify image received, and registering event handlers for image received successfully or unsuccessfully. After successfully receives raw data from the camera, the program will call function of SaveImage from Common Snippets to save images.
  If you would like to know how to convert raw data to format of .NET BITMAP, please refer to A.1.5 for more detail.

C#

```
using var imageReceivedEvent = new System.Threading.AutoResetEvent(false);

// Gets the first data stream of the device. Most devices have one and only one data stream.
var dataStream = device.DataStreams.First();

// Registers event handler for image received failed event
// Usually this is due to system busy or low network quality.
dataStream.ImageReceiveFailed +=
(sender, e) =>
{
    // Records buffer information of the failed buffer.
    Console.WriteLine("failed to receive a buffer: frameId = " + e.Buffer.FrameId);
    Console.WriteLine("    filled size: " + e.Buffer.FilledSize);
    Console.WriteLine("    timestamp: " + e.Buffer.Timestamp);
    Console.WriteLine("    is too small: " + e.Buffer.IsTooSmall);
    Console.WriteLine("    is complete: " + e.Buffer.IsComplete);
    Console.WriteLine("    error status: " + e.Buffer.Nodes.Enums["BufferErrorStatus"]);
    Console.WriteLine("    error message: " + e.Buffer.Nodes.Strings["BufferErrorMessage"]);
};

// Registers event handler for image received event
dataStream.ImageReceived +=
(sender, e) =>
{
    Console.WriteLine("received frame " + e.Buffer.FrameId);
    imageReceivedEvent.Set();

    // Saves the received image.
    // See CommonSnippets/Program.cs for detail steps.
    Snippets.SaveImage(
        e.Buffer.Image,
        "image/" + DateTime.Now.ToString("yyyy-MM-dd-HH-mm-ss-fff") + ".bmp");
```

```
        };
```

- Set up start and stop acquisition, and trigger the camera to capture image for 20 times via software trigger. Finally, close the camera.

C#

```
        // Starts the acquisition process.
        dataStream.StartAcquisition();

        for (int i = 0; i < 20; i++)
        {
            WaitTriggerReady(device);
            device.RemoteNodes[Remote.TriggerSoftware].Execute();

            if (!imageReceivedEvent.WaitOne(1000))
            {
                Console.WriteLine("Image not received after 1 second.");
                break;
            }
        }

        // Stops the acquisition process.
        dataStream.StopAcquisition();

        // Closes the device connection.
        device.Close();
    }

    private static void WaitTriggerReady(ICameraDevice device)
    {
        while (!device.RemoteNodes[Remote.AcquisitionStatus].Value)
        {
            Console.WriteLine("    [wait for trigger ready]");
            System.Threading.Thread.Sleep(1);
        }
    }
```

A.1.4 Demosaic for colorful image

Raw data received from the camera needs to apply demosaic for image processing to render them into colorful image.

Please refer to the following sample code, and modify codes on SaveImage in Common Snippets.

C#

```
/// <summary>
/// This method demonstrates how to save the received image to system.
/// </summary>
/// <param name="image">The target image.</param>
/// <param name="filename">The filename to be save with.</param>
public static void SaveImage(IImageBuffer image, string filename)
{
    if (image == null)
    {
        throw new ArgumentNullException(nameof(image));
    }

    // Here we use 3rd-party library FreeImage to demonstrate the process.
    // You may use other tools to save the image, like
    //      System.Drawing.Bitmap
    //      System.Windows.Media.Imaging.WriteableBitmap (WPF)
    //      ImageSharp
    //      etc.
    // if applicable.

    ImageBuffer demosaicImage = new ImageBuffer();
    int dataSize = 0;

    switch (image.PixelFormat)
    {
        case Delta.Dmvc.Net.PixelFormat.Mono8:
            break;
        case Delta.Dmvc.Net.PixelFormat.BayerBG8:
        case Delta.Dmvc.Net.PixelFormat.BayerGB8:
        case Delta.Dmvc.Net.PixelFormat.BayerGR8:
        case Delta.Dmvc.Net.PixelFormat.BayerRG8:
            // Uses built-in demosaic algorithm to process image
            ImageProcesses.DemosaicToBgr.Execute(image, demosaicImage);
```

```
                    image = demosaicImage;
                    break;
                default:
                    break;
            }
            var dib = FreeImage.ConvertFromRawBits(
                image.DataPtr,
                (int)image.Width,
                (int)image.Height,
                (int)image.Stride,
                (uint)image.PixelFormat.BitPerPixel(),
                0,
                0,
                0,
                true);
            FreeImage.SaveEx(dib, filename);
            FreeImage.Unload(dib);
        }
```

A.1.5 Convert raw data to .NET Bitmap

The following sample code shows how to convert raw data from camera to format of .NET Bitmap. Please refer to below sample code for more details. Note that these codes should run under declaration of namespace of System.Drawing, System.Drawing.Imaging, System.Runtime.InteropServices.

C#

```
private static Bitmap SetBitmap(ICameraDevice device)
{
    // Gets the image parameters from device
    int imgWidth = (int)device.RemoteNodes[Remote.Width].Value;
    int imgHeight = (int)device.RemoteNodes[Remote.Height].Value;
    var pixelFormat = device.RemoteNodes[Remote.PixelFormat].Value;

    var dataSize = imgWidth * imgHeight;
    System.Drawing.Imaging.PixelFormat bitmapFormat;

    ColorPalette palette = null;

    switch (pixelFormat)
    {
        case "Mono8":
            bitmapFormat = System.Drawing.Imaging.PixelFormat.Format8bppIndexed;
            palette = Snippets.CreateMonoPalette();
            break;
        case "BayerRG8":
        case "BayerGR8":
        case "BayerGB8":
        case "BayerBG8":
            dataSize *= 3;    // The dataSize will be three times larger after demosaicing
            bitmapFormat = System.Drawing.Imaging.PixelFormat.Format24bppRgb;
            break;
        default:
            Console.WriteLine($"This sample doesn't support pixel format {pixelFormat}");
            return null;
    }

    // Create a buffer
    var buffer = new byte[dataSize];
```

```
            // Pinning the buffer so that its location won't change by GC
            var pinnedArray = GCHandle.Alloc(buffer, GCHandleType.Pinned);

            // Creates a bitmap from the pinned buffer
            Bitmap image = new Bitmap(
                imgWidth,
                imgHeight,
                dataSize / imgHeight,
                bitmapFormat,
                pinnedArray.AddrOfPinnedObject());
            if (palette != null)
            {
                image.Palette = palette;
            }
            return image;
        }

        public static ColorPalette CreateMonoPalette()
        {
            using (var bitmap = new Bitmap(1, 1, System.Drawing.Imaging.PixelFormat.Format8bppIndexed))
            {
                ColorPalette palette = bitmap.Palette;
                for (int i = 0; i != 256; i++)
                {
                    palette.Entries[i] = Color.FromArgb(i, i, i);
                }

                return palette;
            }
        }
```