China Daheng Group, Inc. Beijing Image Vision Technology Branch

MERCURY2 USB3 Vision Cameras

User Manual

Version: V2.0.16

Date: 2025-07-21

Web: www.daheng-imaging.com/en

Sales Email: isales@daheng-imaging.com

Sales Tel: +86 10 8282 8878-8081

Support Email: isupport@daheng-imaging.com

Preface

We really appreciate your choosing of DAHENG IMAGING products.

The MERCURY2 USB3 Vision camera is DAHENG IMAGING's latest area scan industry camera with high-quality sensor, featuring high resolution, high definition and extremely low noise. The MERCURY2 USB3 Vision cameras are include standard version (MER2-U3(-L) series), Plus version (ME2P-U3 series), Lite version (ME2L-U3(-L) series) and Super version (ME2S-U3 series). The camera is equipped with standard USB3.0 interface, is easy to install and use.

The MERCURY2 USB3 Vision cameras are especially suitable for machine vision applications such as industrial inspection, medical, scientific research, education and so on.

This manual describes in detail on how to install and use the MERCURY2 USB3 Vision industry cameras.

Contents

1. Introduction

1.1. Series Introduction

The MERCURY2 USB3 Vision camera is DAHENG IMAGING's mature area scan industry camera, featuring outstanding performance, powerful features, and outstanding price/performance ratio. The MERCURY2 USB3 Vision cameras are include standard version (MER2-U3(-L) series), Plus version (ME2P-U3 series) , Lite version (ME2L-U3(-L) series) and Super version (ME2S-U3 series). The cameras are available in a variety of resolutions and frame rates, and are available with CMOS sensors from leading chip manufacturers, which is easy to install and use.

The MERCURY2 USB3 Vision camera transmits image data through the USB3.0 data interface. Thanks to the locking screw connectors, the MERCURY2 USB3 Vision cameras can secure the reliability of cameras deployed in harsh industrial environments. Featuring high reliability and high price/performance ratio, the MERCURY2 USB3 Vision cameras are especially suitable for machine vision applications such as industrial inspection, medical, scientific research, education and so on.

1.2. Naming Rules

Details of the MERCURY2 USB3 Vision camera are given in the general specifications below. Each camera model name is determined by its sensor's maximum resolution, maximum frame rate at maximum resolution, the color/monochrome type of the sensor, etc.

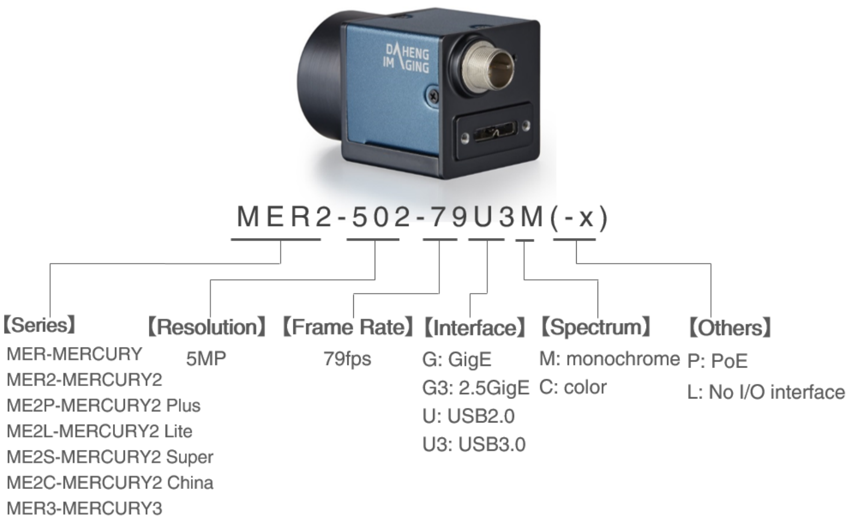


Figure 1-1 Naming rules

1.3. Standards

The camera follows the USB3 Vision1.0 standard, and its development interface GalaxySDK is implemented based on the GEN<i>CAM standard.

1.4. Document, CAD/Technical Drawing and Software Downloads

Product related document, CAD/Technical drawing and software can be downloaded from the Downloads of DAHENG IMAGING website.

2. Precautions

2.1. Safety Claim

Before installing and using DAHENG IMAGING products, please carefully read this manual and strictly comply with the usage requirements. And ensure to use the product in specified conditions, otherwise it may cause equipment malfunction. Our company will not bear any legal responsibility for any damage or injury caused by improper use of this product and disregard of safety instructions.

The symbols that may be found in this document are defined as follows:

Symbol	Description
(i)	Note: Provides additional information to emphasize or supplement important points of the main text
	Caution: Indicates a potentially hazardous situation which, if not avoided, could result in equipment damage, data loss, performance degradation, or unexpected results
⚠	Warning: Indicates a potential risk that, if not avoided, could result in injury accidents, equipment damage, or business interruption
	Danger: Indicates a hazard with a high level of risk, which if not avoided, will result in death or serious injury

2.2. Safety Instruction

Usage	
⚠ Warning	1) Do not install and operate the product in extreme environments with vibration, high temperature, humidity, dust, strong magnetic fields, explosive/corrosive smoke or gases, as it may damage the camera, cause a fire or electric shock. 2) Do not aim at the product with high intensity light sources directly, as it may damage the sensor. 3) If the device damaged, emits smoke, odor or noise, please turn off the power and unplug the power cord immediately, and contact our technical support engineer. 4) Unauthorized disassembly, repair, or modification of products is prohibited as it may damage the camera or cause a risk of electric shock. 5) In the use of the device, you must be in strict compliance with the electrical safety regulations of the nation and region. 6) Please use the power supply provided by reputable manufacturers that meets the camera power limit requirements, otherwise, it will damage the camera.
(i) Notice	1) Check whether the device's package is in good condition, whether there is damage, deformation, etc. before unpacking. 2) After unpacking, please carefully inspect the quantity and appearance of the product and accessories for any abnormalities. 3) Please store and transport the product according to the specified storage and transportation conditions, ensure that the storage temperature and humidity meet the requirements.

Personal Safety	
Warning	1) It is strictly prohibited to perform device wiring, dismantling, maintenance and other operations while powered on, otherwise there may be a risk of electric shock. 2) It is prohibited to touch the camera directly during using, otherwise there may be a risk of burns. 3) Please install and use the camera in accordance with regulations, otherwise there may be a risk of falling and get injured. 4) The edges of the lens mount and fan are relatively sharp, so pay attention to the risk of scratches during installation or use.

2.3. Guideline for Avoiding EMI and ESD

You should consider the EMI (Electro Magnetic Interference) and ESD (Electro-Static discharge) problem in the process of using the camera, to guarantee the camera to work in a relatively good electromagnetic environment. The main measures are as follows:

1) USB cables certificated by USB IF with lock screw are recommended.

2) Using shielded cable can avoid electro-magnetic interface. Shielding layer of the cable should conduct to ground nearby and not until stretched too long. When many devices need conduct to ground, using single point grounding to avoid earth loop.

3) Keep your cameras away from equipment with high voltage, or high current (such as motor, inverter, relay, etc.). If necessary, use additional shielding.

4) ESD (electro-static discharge) may damage cameras permanently, so use suitable clothing (cotton) and shoes, and touch the metal to discharge the electro-static before operating cameras.

2.4. Environmental Requirements

1) Housing temperature during operation: 0°C ~ 45°C, humidity during operation: 10% ~ 80%.

   Storage temperature: -20°C ~ 70°C.

2) To avoid collecting dust in the optical filter, always keep the plastic cap on cameras when no lens is mounted.

3) PC requirement: Intel Core 2 Duo, 2.4GHz or above, and 2GB memory or above.

4) USB3.0 host controller requirement: Intel controller integrated in mainboard is recommend. Select Renesas controller if external frame grabber is needed.

5) The cable must have a locking screw at the end of the device.

6) Make sure that cameras are transported in the original factory packages.

2.5. Camera Mechanical Installation Precautions

Camera installation requirements:

1) The M3 screw and the camera should have a screw length between 2.5mm and 2.7mm, and the M2 screw and the camera should have a screw length between 3mm and 3.3mm

2) The M3 screw assembly torque ≤ 1N·m, and the M2 screw assembly torque ≤ 0.5N·m. If the screw assembly torque is too large, it may cause the camera thread stripping.

2.6. Certification and Declaration

1) CE, RoHS

We declare that DAHENG IMAGING MERCURY2 USB3 Vision industry cameras have passed the following EU certifications:

- 2014/30/EU—Electromagnetic Compatibility Restriction
- 2011/65/EU—Restriction of Hazardous Substances (RoHS) and its revised directive 2015/863/EU

⚠ Equipment meeting Class A requirements may not offer adequate protection to broadcast services within a residential environment.

2) FCC

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- This device may not cause harmful interference
- This device must accept any interference received, including interference that may cause undesired operation

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment can generate, uses, and radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

3. Installation

3.1. Host Preparation

3.1.1. Software Package

The software package of DAHENG IMAGING's MERCURY2 USB3 Vision camera is used to control the MERCURY2 USB3 Vision camera to provide stable, real-time image transmission, and provides multiple samples and easy-to-integrate SDKs for various programming tools. The package is composed of the following modules:

1) Driver Package (Driver): This package provides the MERCURY2 camera driver program, such as: the USB3.0 cameras' driver program.

2) Interface Library (API): This package provides the camera control interface library and the image processing interface library, supports the user for secondary development.

3) Demonstration Program (GalaxyView.exe): This demonstration program is used to display the camera control, image acquisition and image processing functions, the user can control the camera directly by the demonstration program, and the user can develop their own control program based on the camera interface library.

4) Sample: These samples demonstrate cameras' functions, the user can easily use these samples to control cameras, or refer to the samples to develop their own control programs.

5) Programmer's Manual: This manual is the users programming guide that instructs the users how to configure the programming environment and how to control cameras and acquire images through the camera interface library.

You can download the latest software package from the website: www.daheng-imaging.com/en/Downloads.

3.1.2. User Software Interface

After installing the MERCURY2 USB3 Vision camera software package, the user can use the demonstration program and the samples to control the camera, also the user can control the camera by the program which is written by the user themselves. The software package provides three kinds of program interface, the user can select the suitable one for use according to their own requirements:

1) API Interface

In order to simplify the users' programming complexity, the package provides the general C programming interface GxIAPI.dll and image processing algorithm interface DxImageProc.dll for the user to control the camera, and provides the samples and software development manual which are based on these interfaces. The API interface supports C/C++/C#/Python, etc.

2) GenTL Interface

This interface is developed according to the standard of general transport layer in GEN<i>CAM standard, DAHENG IMAGING follows the GEN<i>CAM standard and provides the GenTL interface for the user, and the user can use the GenTL interface directly to develop their own control program. The definition and usage of GenTL interfaces can be downloaded from the website of EMVA.

In addition, users can use some third-party software that supports GEN<i>CAM standard to control the camera, such as HALCON.

3) USB3 Vision interface

The MERCURY2 USB3.0 camera is compatible with the USB3 Vision protocol, which allows the user to control the camera directly through the USB3 Vision protocol. In addition, the user can use some third-party software that supports the USB3 Vision protocol to control the camera, such as HALCON.

- Note

GEN<i>CAM standard: GEN<i>CAM is administered by the European Machine Vision Association (EMVA). GenICam provides a generic programming interface for all kinds of cameras and devices. It provides a standard application programming interface (API), no matter what interface technology is being used. It mainly includes the following modules:

- GenAPI: an XML description file format defining how to capture the features of a device and how to access and control these features in a standard way
- GenTL: a generic Transport Layer Interface, between software drivers and libraries, that transports the image data from the camera to the application running on a PC
- SFNC: common naming convention for camera features, which promotes interoperability between products from different manufacturers

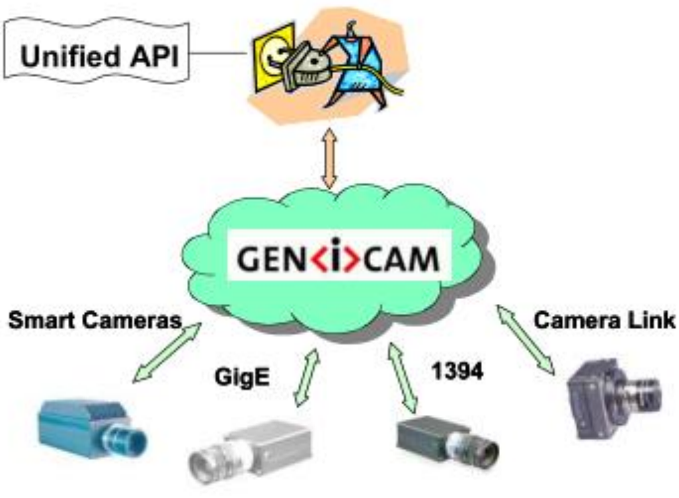


Figure 3-1 GEN<i>CAM standard schematic diagram

3.2. Camera Power

Due to different power consumption, Camera power are divided into two types:

Type 1: Camera is powered by the USB 3.0 interface.

Type 2: High power consumption camera recommends get power from the Hirose I/O port, and the operating voltage is +12VDC (±10%) ~ +24VDC (±10%). The model that recommends external power supply has been marked in the factory. If the power supply to the USB 3.0 interface is insufficient, the camera may not work properly.

⚠ Cameras that only support an external power supply will work when the USB3.0 cable and the external power supply are properly connected to the camera at the same time.

3.3. Camera Driver Installation

3.3.1. System Requirements

GalaxySDK is suitable for all cameras in the MERCURY2. The GalaxySDK contains various operating systems such as Windows, Android and Linux. The requirements for the operating system and version of the installation package are as follows:

Operating Systems	Applicable Version
Windows	➢ Windows 7 (32bit, 64bit) ➢ Windows 10 (32bit, 64bit) ➢ Windows 11 (64bit)
Linux	➢ Ubuntu 12.04 or above, kernel version 3.5.0.23 or above
Android	➢ Android 6 or above

3.3.2. Driver Installation

The steps to install the Galaxy SDK under Windows are as follows:

1) Download the corresponding version of the installation package from www.daheng-imaging.com/en/Downloads.

2) Run the installer.

3) Follow the instructions of the installation wizard to complete the installation process. During the installation process, you can choose the camera interface you need (USB2.0, USB3 Vision, GigE Vision, etc.).

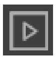
During the installation process, especially when installing the *.sys file, you must always pay attention to whether the anti-virus software intercepts the driver. If intercepted, it may cause the driver installation to fail.

3.4. Open Device and Start Acquisition

After powering the device, connecting the device to the USB3.0 interface of the host. Double-click the GalaxyView software to acquire image. The steps are as follows:

1) Click the  icon on the Device Tree in the GalaxyView to refresh device list.

2) After the device is enumerated, double-click the device enumerated in the device list.

3) Click the  icon on the Device Tree to perform the Start Acquisition operation on the current device.

4. General Specification

4.1. Explanation of Important Parameters

4.1.1. About Spectral Response

QE: Quantum efficiency, which is the ratio of the average number of photoelectrons produced per unit time to the number of incident photons at a given wavelength.

Sensitivity: The change of the sensor output signal relative to the incident light energy. The commonly used sensitivity units are V/((W/m2)·s), V/lux·s, e-/((W/m2)·s) or DN/ ((W/m2)·s).

The spectral response graphs given by different manufacturers are different. Some graphs' ordinate is relative sensitivity response, and abscissa is wavelength. Some graphs' ordinate is QE, and abscissa is wavelength.

4.2. MER2-U3(-L) Series

4.2.1. MER2-041-436U3M/C(-L)

Specifications	MER2-041-436U3C MER2-041-436U3C-L	MER2-041-436U3M MER2-041-436U3M-L
Resolution	720 × 540	
Sensor	Sony IMX287 global shutter CMOS	
Max. Image Circle	1/2.9 inch	
Pixel Size	6.9μm × 6.9μm	
Frame Rate	438fps@720 × 540	
ADC Bit Depth	10bit	
Pixel Bit Depth	8bit, 10bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer RG8/Bayer RG10	Mono8/Mono10
Signal Noise Ratio	44dB	43.46dB
Exposure Time	Standard: 20μs~1s, Actual Steps: 1 row period	
Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB	
Binning	N/A	

Decimation	N/A
Synchronization	Hardware trigger (MER2-U3-L: N/A), software trigger
I/O	1 input and 1 output with opto-isolated, 2 programmable GPIOs (MER2-U3-L: N/A)
Operating Temp.	0°C~45°C
Storage Temp.	-20°C~70°C
Operating Humidity	10%~80%
Typical Power	1.66W@5V
Power Requirements	Power over USB3.0
Lens Mount	C
Data Interface	USB3.0
Dimensions	29mm×29mm×29mm (without lens adapter or connectors)
Weight	MER2-U3: 65g, MER2-U3-L: 61g
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8
Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity (MER2-U3-L not support trigger polarity and flash polarity)
Conformity	CE, RoHS, FCC, ICES, UKCA, UL, USB3 Vision, GenICam

Table 4-1 MER2-041-436U3M/C(-L) camera specifications

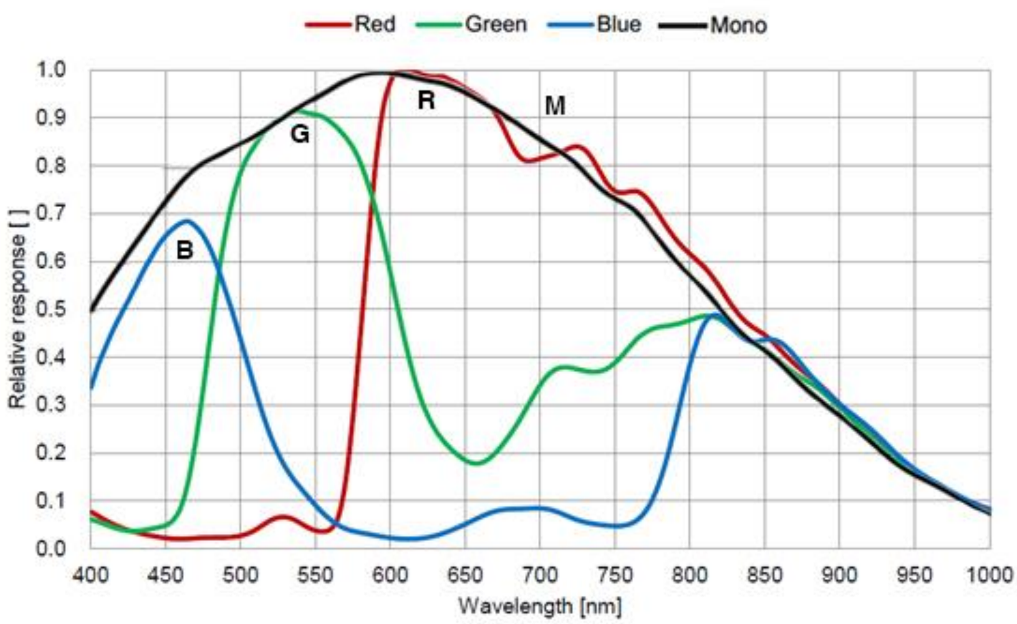


Figure 4-1 MER2-041-436U3M/C(-L) sensor spectral response

4.2.2. MER2-041-528U3M/C(-L)

Specifications	MER2-041-528U3C MER2-041-528U3C-L	MER2-041-528U3M MER2-041-528U3M-L
Resolution	720 × 540	
Sensor	Sony IMX287 global shutter CMOS	
Max. Image Circle	1/2.9 inch	
Pixel Size	6.9μm × 6.9μm	
Frame Rate	528.5fps@720 × 540	
ADC Bit Depth	8bit, 10bit, 12bit	
Pixel Bit Depth	8bit, 10bit, 12bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer RG8/Bayer RG10/Bayer RG12	Mono8/Mono10/Mono12
Signal Noise Ratio	44dB	43.46dB
Exposure Time	UltraShort: 1μs~100μs, Actual Steps: 1μs Standard: 20μs~1s, Actual Steps: 1 row period	
Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB	
Binning	1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4	
Decimation	FPGA: 1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4	
Synchronization	Hardware trigger (MER2-U3-L: N/A), software trigger	
I/O	1 input and 1 output with opto-isolated, 2 programmable GPIOs (MER2-U3-L: N/A)	
Operating Temp.	0°C~45°C	
Storage Temp.	-20°C~70°C	
Operating Humidity	10%~80%	
Typical Power	1.66W@5V	
Power Requirements	Power over USB3.0	
Lens Mount	C	
Data Interface	USB3.0	
Dimensions	29mm×29mm×29mm (without lens adapter or connectors)	
Weight	MER2-U3: 65g, MER2-U3-L: 61g	
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8	

Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity (MER2-U3-L not support trigger polarity and flash polarity)
Conformity	CE, RoHS, FCC, ICES, UKCA, UL, USB3 Vision, GenICam

Table 4-2 MER2-041-528U3M/C(-L) camera specifications

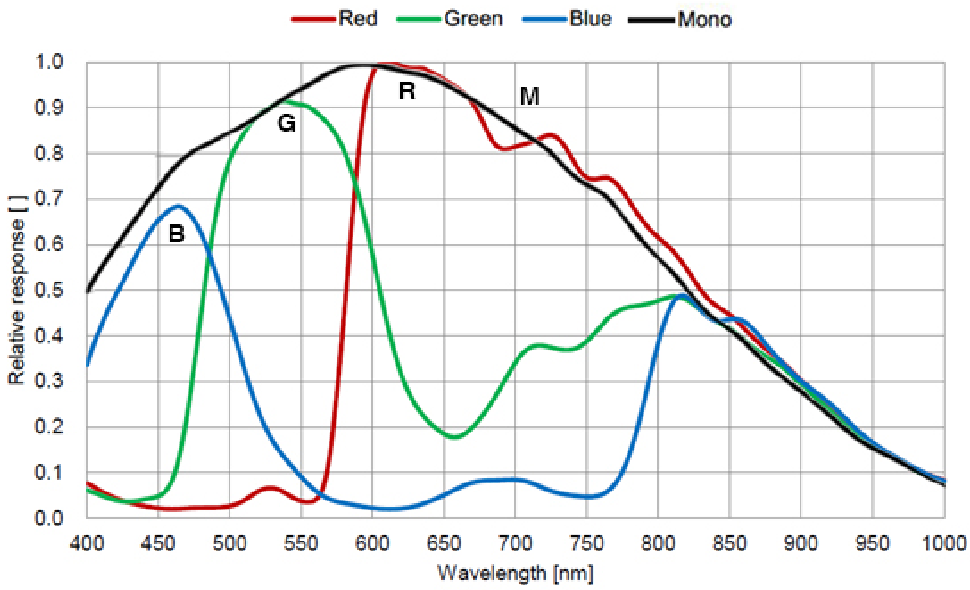


Figure 4-2 MER2-041-528U3M/C(-L) sensor spectral response

4.2.3. MER2-060-642U3M(-L)

Specifications	MER2-060-642U3M MER2-060-642U3M-L
Resolution	1024 × 600
Sensor	global shutter CMOS
Max. Image Circle	1/1.7 inch
Pixel Size	8.0μm × 8.0μm
Frame Rate	642.6fps@1024 × 600, 944.3fps@720 × 540, 1051.5fps@640 × 480
ADC Bit Depth	10bit
Pixel Bit Depth	8bit, 10bit
Mono/Color	Mono
Pixel Formats	Mono8/Mono10
Signal Noise Ratio	40.53dB
Exposure Time	Standard: 7μs~1s, Actual Steps: 1μs
Gain	0dB~16dB, Default: 0dB, Steps: 0.1dB

Binning	1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4
Decimation	FPGA: 1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4
Synchronization	Hardware trigger (MER2-U3-L: N/A), software trigger
I/O	1 input and 1 output with opto-isolated, 2 programmable GPIOs (MER2-U3-L: N/A)
Operating Temp.	0°C~45°C
Storage Temp.	-20°C~70°C
Operating Humidity	10%~80%
Typical Power	2.12W@5V
Power Requirements	Power over USB3.0
Lens Mount	C
Data Interface	USB3.0
Dimensions	29mm×29mm×29mm (without lens adapter or connectors)
Weight	MER2-U3: 65g, MER2-U3-L: 61g
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8
Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity (MER2-U3-L not support trigger polarity and flash polarity)
Conformity	CE, RoHS, FCC, ICES, UKCA, UL, USB3 Vision, GenICam

Table 4-3 MER2-060-642U3M(-L) camera specifications

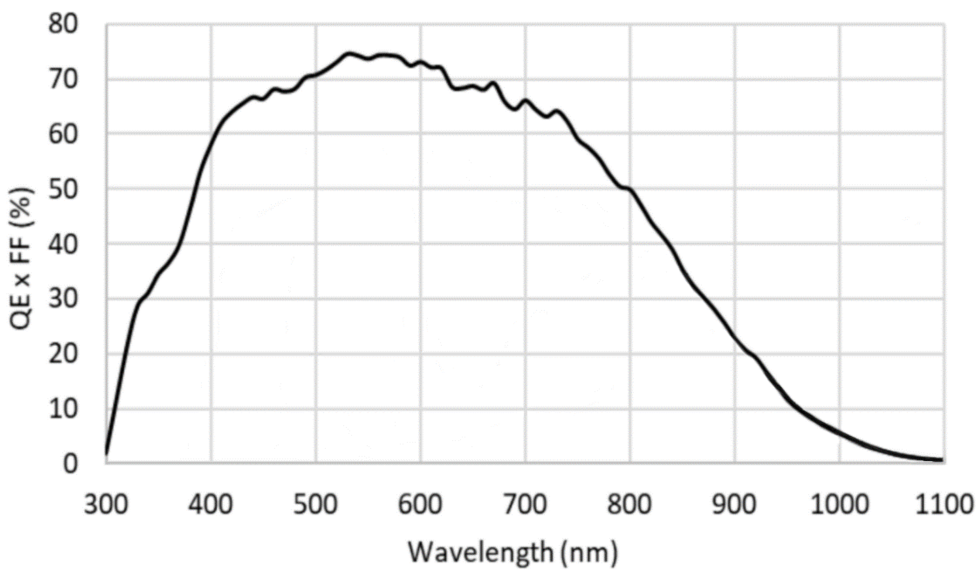


Figure 4-3 MER2-060-642U3M(-L) sensor spectral response

4.2.4. MER2-135-150U3M/C(-L)

Specifications	MER2-135-150U3C MER2-135-150U3C-L	MER2-135-150U3M MER2-135-150U3M-L
Resolution	1280 × 1024	
Sensor	SmartSens SC130GS global shutter CMOS	
Max. Image Circle	1/2.7 inch	
Pixel Size	4.0μm × 4.0μm	
Frame Rate	150fps@1280 × 1024	
ADC Bit Depth	10bit	
Pixel Bit Depth	8bit, 10bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer BG8/Bayer BG10	Mono8/Mono10
Signal Noise Ratio	38.96dB	39.19dB
Exposure Time	Standard: 8μs~1s, Actual Steps: 2 row periods	
Gain	0dB~16dB, Default: 0dB, Steps: 0.1dB	
Binning	1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4	
Decimation	Sensor: 1×1, 1×2, 2×1, 2×2	
Synchronization	Hardware trigger (MER2-U3-L: N/A), software trigger	
I/O	1 input and 1 output with opto-isolated, 2 programmable GPIOs (MER2-U3-L: N/A)	
Operating Temp.	0°C~45°C	
Storage Temp.	-20°C~70°C	
Operating Humidity	10%~80%	
Typical Power	1.22W@5V	
Power Requirements	Power over USB3.0	
Lens Mount	C	
Data Interface	USB3.0	
Dimensions	29mm×29mm×29mm (without lens adapter or connectors)	
Weight	MER2-U3: 65g, MER2-U3-L: 61g	
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8	

Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity (MER2-U3-L not support trigger polarity and flash polarity)
Conformity	CE, RoHS, FCC, ICES, UKCA, UL, USB3 Vision, GenICam

Table 4-4 MER2-135-150U3M/C(-L) camera specifications

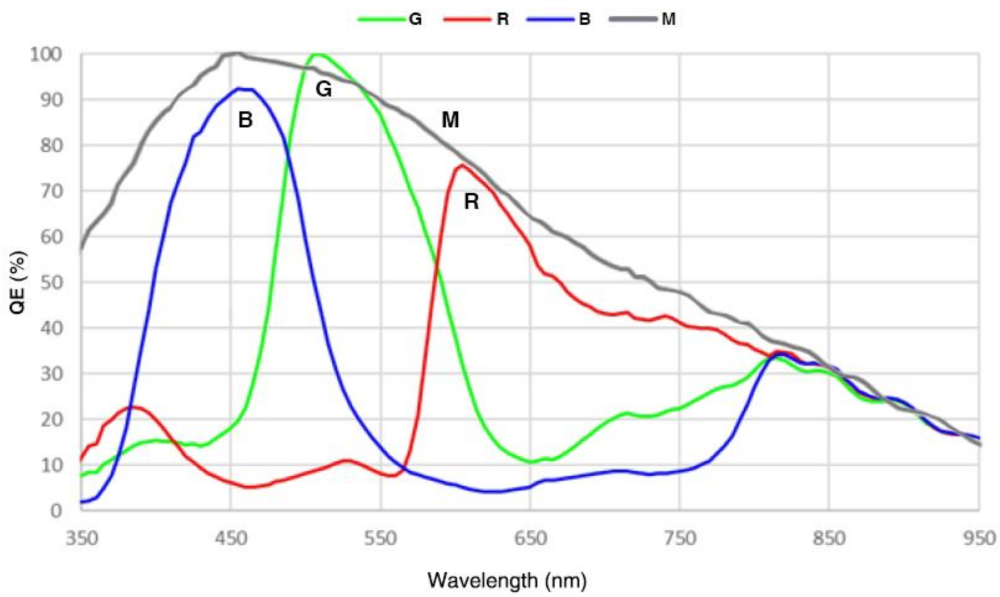


Figure 4-4 MER2-135-150U3M/C(-L) sensor spectral response

4.2.5. MER2-135-208U3M/C(-L)

Specifications	MER2-135-208U3C MER2-135-208U3C-L	MER2-135-208U3M MER2-135-208U3M-L
Resolution	1280 × 1024	
Sensor	SmartSens SC130GS global shutter CMOS	
Max. Image Circle	1/2.7 inch	
Pixel Size	4.0μm × 4.0μm	
Frame Rate	208.5fps@1280 × 1024	
ADC Bit Depth	10bit	
Pixel Bit Depth	8bit, 10bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer BG8/Bayer BG10	Mono8/Mono10
Signal Noise Ratio	38.96dB	39.19dB
Exposure Time	Standard: 8μs~1s, Actual Steps: 2 row periods	

Gain	0dB~16dB, Default: 0dB, Steps: 0.1dB
Binning	1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4
Decimation	Sensor: 1×1, 1×2, 2×1, 2×2
Synchronization	Hardware trigger (MER2-U3-L: N/A), software trigger
I/O	1 input and 1 output with opto-isolated, 2 programmable GPIOs (MER2-U3-L: N/A)
Operating Temp.	0°C~45°C
Storage Temp.	-20°C~70°C
Operating Humidity	10%~80%
Typical Power	2.06W@5V
Power Requirements	Power over USB3.0
Lens Mount	C
Data Interface	USB3.0
Dimensions	29mm×29mm×29mm (without lens adapter or connectors)
Weight	MER2-U3: 65g, MER2-U3-L: 61g
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8
Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity (MER2-U3-L not support trigger polarity and flash polarity)
Conformity	CE, RoHS, FCC, ICES, UKCA, UL, USB3 Vision, GenICam

Table 4-5 MER2-135-208U3M/C(-L) camera specifications

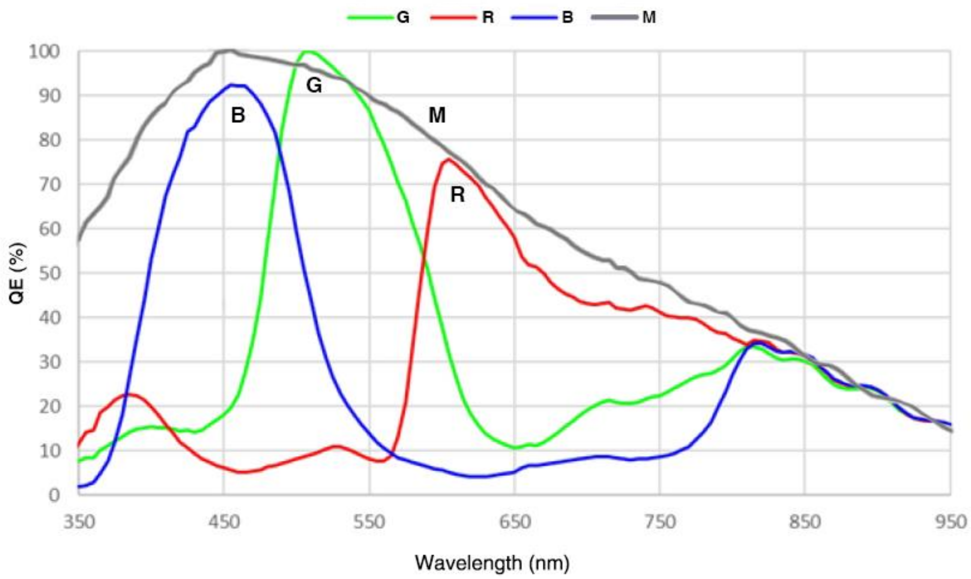


Figure 4-5 MER2-135-208U3M/C(-L) sensor spectral response

4.2.6. MER2-160-227U3M/C(-L)

Specifications	MER2-160-227U3C MER2-160-227U3C-L	MER2-160-227U3M MER2-160-227U3M-L
Resolution	1440 × 1080	
Sensor	Sony IMX273 global shutter CMOS	
Max. Image Circle	1/2.9 inch	
Pixel Size	3.45μm × 3.45μm	
Frame Rate	227fps@1440 × 1080	
ADC Bit Depth	10bit	
Pixel Bit Depth	8bit, 10bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer RG8/Bayer RG10	Mono8/Mono10
Signal Noise Ratio	41dB	41dB
Exposure Time	UltraShort: 1μs~100μs, Actual Steps: 1μs Standard: 20μs~1s, Actual Steps: 1 row period	
Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB	
Binning	1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4	
Decimation	Sensor: 1×1, 2×2	
Synchronization	Hardware trigger (MER2-U3-L: N/A), software trigger	
I/O	1 input and 1 output with opto-isolated, 2 programmable GPIOs (MER2-U3-L: N/A)	
Operating Temp.	0°C~45°C	
Storage Temp.	-20°C~70°C	
Operating Humidity	10%~80%	
Typical Power	1.70W@5V	
Power Requirements	Power over USB3.0	
Lens Mount	C	
Data Interface	USB3.0	
Dimensions	29mm×29mm×29mm (without lens adapter or connectors)	
Weight	MER2-U3: 65g, MER2-U3-L: 61g	
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8	

Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity (MER2-U3-L not support trigger polarity and flash polarity)
Conformity	CE, RoHS, FCC, ICES, UKCA, UL, USB3 Vision, GenICam

Table 4-6 MER2-160-227U3M/C(-L) camera specifications

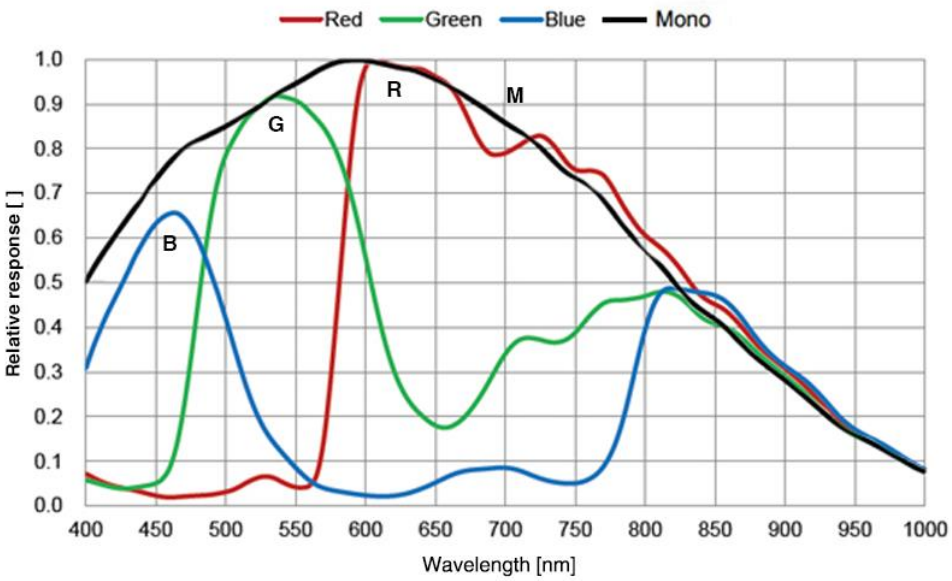


Figure 4-6 MER2-160-227U3M/C(-L) sensor spectral response

4.2.7. MER2-230-168U3M/C(-L)

Specifications	MER2-230-168U3C MER2-230-168U3C-L	MER2-230-168U3M MER2-230-168U3M-L
Resolution	1920 × 1200	
Sensor	Sony IMX174 global shutter CMOS	
Max. Image Circle	1/1.2 inch	
Pixel Size	5.86μm × 5.86μm	
Frame Rate	168fps@1920 × 1200	
ADC Bit Depth	10bit	
Pixel Bit Depth	8bit, 10bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer RG8/Bayer RG10	Mono8/Mono10
Signal Noise Ratio	45.32dB	45.32dB
Exposure Time	Standard: 20μs~1s, Actual Steps: 1 row period	
Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB	

Binning	1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4
Decimation	FPGA: 1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4
Synchronization	Hardware trigger (MER2-U3-L: N/A), software trigger
I/O	1 input and 1 output with opto-isolated, 2 programmable GPIOs (MER2-U3-L: N/A)
Operating Temp.	0°C~45°C
Storage Temp.	-20°C~70°C
Operating Humidity	10%~80%
Typical Power	2.36W@5V
Power Requirements	Power over USB3.0
Lens Mount	C
Data Interface	USB3.0
Dimensions	29mm×29mm×29mm (without lens adapter or connectors)
Weight	MER2-U3: 65g, MER2-U3-L: 61g
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8
Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity (MER2-U3-L not support trigger polarity and flash polarity)
Conformity	CE, RoHS, FCC, ICES, UKCA, UL, USB3 Vision, GenICam

Table 4-7 MER2-230-168U3M/C(-L) camera specifications

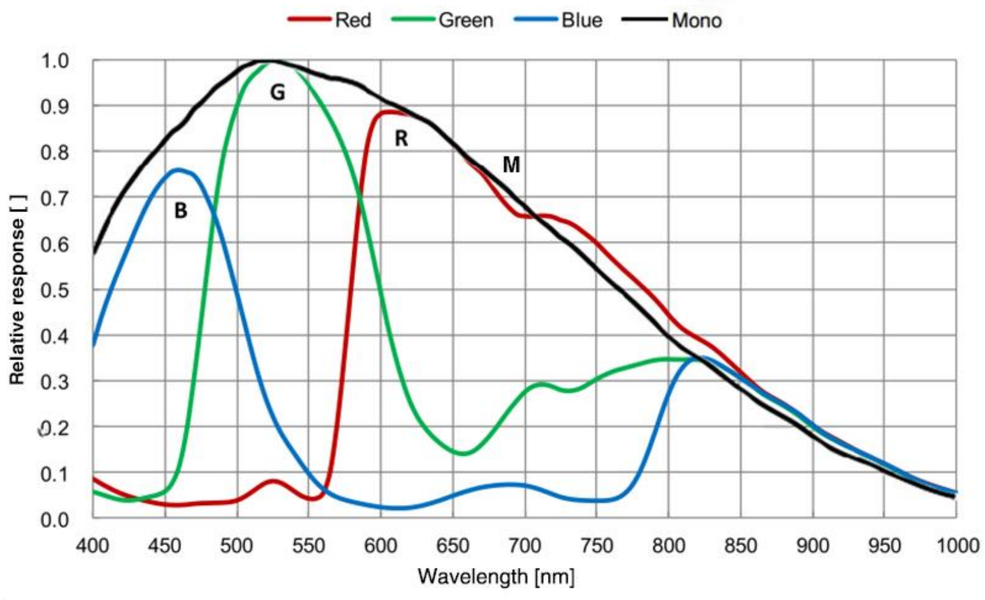


Figure 4-7 MER2-230-168U3M/C(-L) sensor spectral response

4.2.8. MER2-231-41U3M/C(-L)

Specifications	MER2-231-41U3C MER2-231-41U3C-L	MER2-231-41U3M MER2-231-41U3M-L
Resolution	1920 × 1200	
Sensor	Sony IMX249 global shutter CMOS	
Max. Image Circle	1/1.2 inch	
Pixel Size	5.86μm × 5.86μm	
Frame Rate	41fps@1920 × 1200	
ADC Bit Depth	12bit	
Pixel Bit Depth	8bit, 10bit, 12bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer RG8/Bayer RG10/Bayer RG12	Mono8/Mono10/Mono12
Signal Noise Ratio	45.33dB	45.33dB
Exposure Time	Standard: 20μs~1s, Actual Steps: 1 row period	
Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB	
Binning	1×1, 1×2, 2×1, 2×2	
Decimation	FPGA: 1×1, 1×2, 2×1, 2×2	
Synchronization	Hardware trigger (MER2-U3-L: N/A), software trigger	
I/O	1 input and 1 output with opto-isolated, 2 programmable GPIOs (MER2-U3-L: N/A)	
Operating Temp.	0°C~45°C	
Storage Temp.	-20°C~70°C	
Operating Humidity	10%~80%	
Typical Power	1.70W@5V	
Power Requirements	Power over USB3.0	
Lens Mount	C	
Data Interface	USB3.0	
Dimensions	29mm×29mm×29mm (without lens adapter or connectors)	
Weight	MER2-U3: 65g, MER2-U3-L: 61g	
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8	

Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity (MER2-U3-L not support trigger polarity and flash polarity)
Conformity	CE, RoHS, FCC, ICES, UKCA, UL, USB3 Vision, GenICam

Table 4-8 MER2-231-41U3M/C(-L) camera specifications

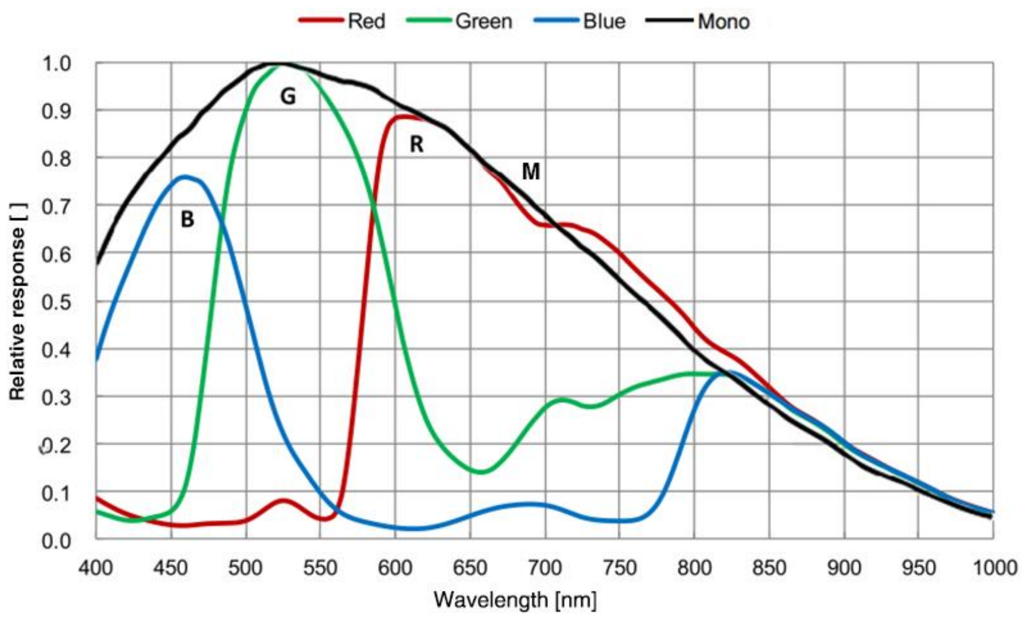


Figure 4-8 MER2-231-41U3M/C(-L) sensor spectral response

4.2.9. MER2-240-159U3M/C(-L)

Specifications	MER2-240-159U3C MER2-240-159U3C-L	MER2-240-159U3M MER2-240-159U3M-L
Resolution	2048 × 1200	
Sensor	Gpixel GMAX4002 global shutter CMOS	
Max. Image Circle	1/1.7 inch	
Pixel Size	4μm × 4μm	
Frame Rate	159.4fps@2048 × 1200	
ADC Bit Depth	12bit	
Pixel Bit Depth	8bit, 10bit, 12bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer GB8/Bayer GB10/Bayer GB12	Mono8/Mono10/Mono12
Signal Noise Ratio	39.89dB	39.98dB
Exposure Time	Standard: 7μs~1s, Actual Steps: 1μs	

Gain	0dB~16dB, Default: 0dB, Steps: 0.1dB
Binning	1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4
Decimation	Horizontal FPGA, Vertical Sensor: 1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4
Synchronization	Hardware trigger (MER2-U3-L: N/A), software trigger
I/O	1 input and 1 output with opto-isolated, 2 programmable GPIOs (MER2-U3-L: N/A)
Operating Temp.	0°C~45°C
Storage Temp.	-20°C~70°C
Operating Humidity	10%~80%
Typical Power	2.22W@5V
Power Requirements	Power over USB3.0
Lens Mount	C
Data Interface	USB3.0
Dimensions	29mm×29mm×29mm (without lens adapter or connectors)
Weight	MER2-U3: 65g, MER2-U3-L: 61g
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8
Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity (MER2-U3-L not support trigger polarity and flash polarity)
Conformity	CE, RoHS, FCC, ICES, UKCA, UL, USB3 Vision, GenICam

Table 4-9 MER2-240-159U3M/C(-L) camera specifications

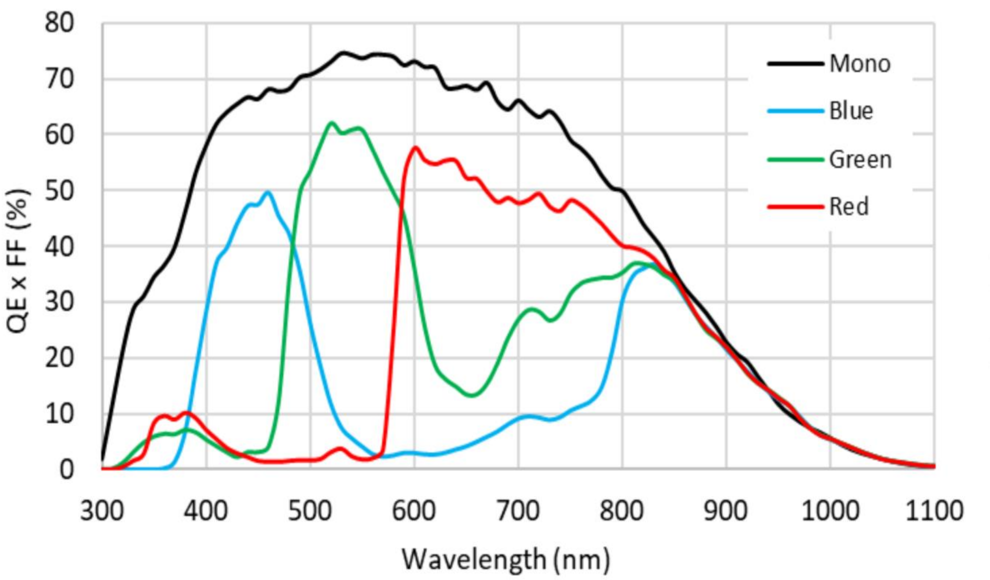


Figure 4-9 MER2-240-159U3M/C(-L) sensor spectral response

4.2.10. MER2-280-139U3M/C(-L)

Specifications	MER2-280-139U3C MER2-280-139U3C-L	MER2-280-139U3M MER2-280-139U3M-L
Resolution	1936 × 1464	
Sensor	Sony IMX421 global shutter CMOS	
Max. Image Circle	2/3 inch	
Pixel Size	4.5μm × 4.5μm	
Frame Rate	139.2fps@1936 × 1464	
ADC Bit Depth	10bit, 12bit	
Pixel Bit Depth	8bit, 10bit, 12bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer RG8/Bayer RG10/Bayer RG12	Mono8/Mono10/Mono12
Signal Noise Ratio	43.9dB	44dB
Exposure Time	UltraShort: 1μs~5μs, Actual Steps: 0.1μs Standard: 9μs~1s, Actual Steps: 1 row period	
Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB	
Binning	FPGA: 1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4	
Decimation	Sensor: 1×1, 2×2	
Synchronization	Hardware trigger (MER2-U3-L: N/A), software trigger	
I/O	1 input and 1 output with opto-isolated, 2 programmable GPIOs (MER2-U3-L: N/A)	
Operating Temp.	0°C~45°C	
Storage Temp.	-20°C~70°C	
Operating Humidity	10%~80%	
Typical Power	2.95W@5V	
Power Requirements	Power over USB3.0	
Lens Mount	C	
Data Interface	USB3.0	
Dimensions	29mm×29mm×29mm (without lens adapter or connectors)	
Weight	MER2-U3: 65g, MER2-U3-L: 61g	
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8	

Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity (MER2-U3-L not support trigger polarity and flash polarity)
Conformity	CE, RoHS, FCC, ICES, UKCA, UL, USB3 Vision, GenICam

Table 4-10 MER2-280-139U3M/C(-L) camera specifications

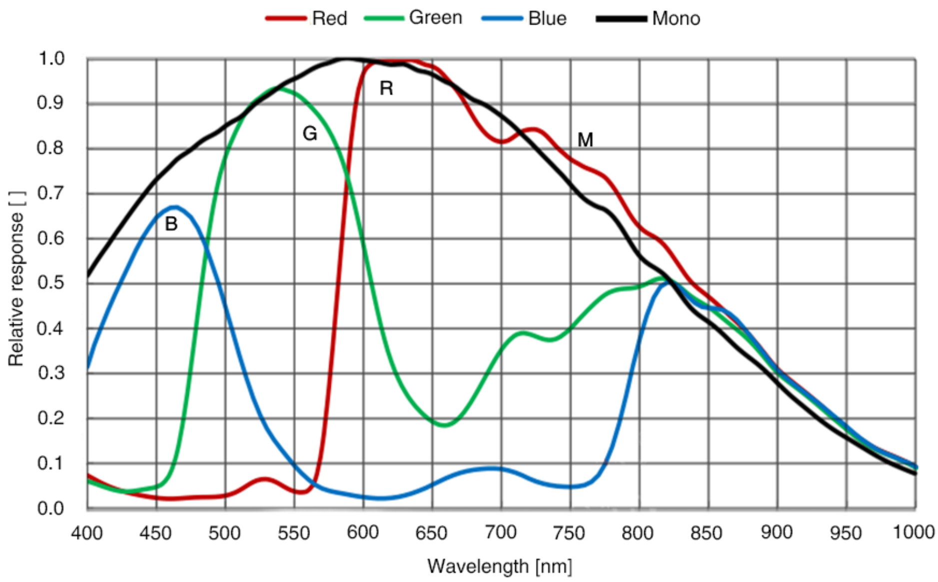


Figure 4-10 MER2-280-139U3M/C(-L) sensor spectral response

4.2.11. MER2-301-125U3M/C(-L)

Specifications	MER2-301-125U3C MER2-301-125U3C-L	MER2-301-125U3M MER2-301-125U3M-L
Resolution	2048 × 1536	
Sensor	Sony IMX252 global shutter CMOS	
Max. Image Circle	1/1.8 inch	
Pixel Size	3.45μm × 3.45μm	
Frame Rate	125fps@2048 × 1536	
ADC Bit Depth	10bit	
Pixel Bit Depth	8bit, 10bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer RG8/Bayer RG10	Mono8/Mono10
Signal Noise Ratio	40.63dB	40.55dB
Exposure Time	UltraShort: 1μs~100μs, Actual Steps: 1μs Standard: 20μs~1s, Actual Steps: 1 row period	
Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB	

Binning	FPGA: 1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4 Sensor: 1×1, 1×2 (MER2-U3M(-L) only)
Decimation	Sensor: 1×1, 2×2
Synchronization	Hardware trigger (MER2-U3-L: N/A), software trigger
I/O	1 input and 1 output with opto-isolated, 2 programmable GPIOs (MER2-U3-L: N/A)
Operating Temp.	0°C~45°C
Storage Temp.	-20°C~70°C
Operating Humidity	10%~80%
Typical Power	2.29W@5V
Power Requirements	Power over USB3.0
Lens Mount	C
Data Interface	USB3.0
Dimensions	29mm×29mm×29mm (without lens adapter or connectors)
Weight	MER2-U3: 65g, MER2-U3-L: 61g
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8
Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity (MER2-U3-L not support trigger polarity and flash polarity)
Conformity	CE, RoHS, FCC, ICES, UKCA, UL, USB3 Vision, GenICam

Table 4-11 MER2-301-125U3M/C(-L) camera specifications

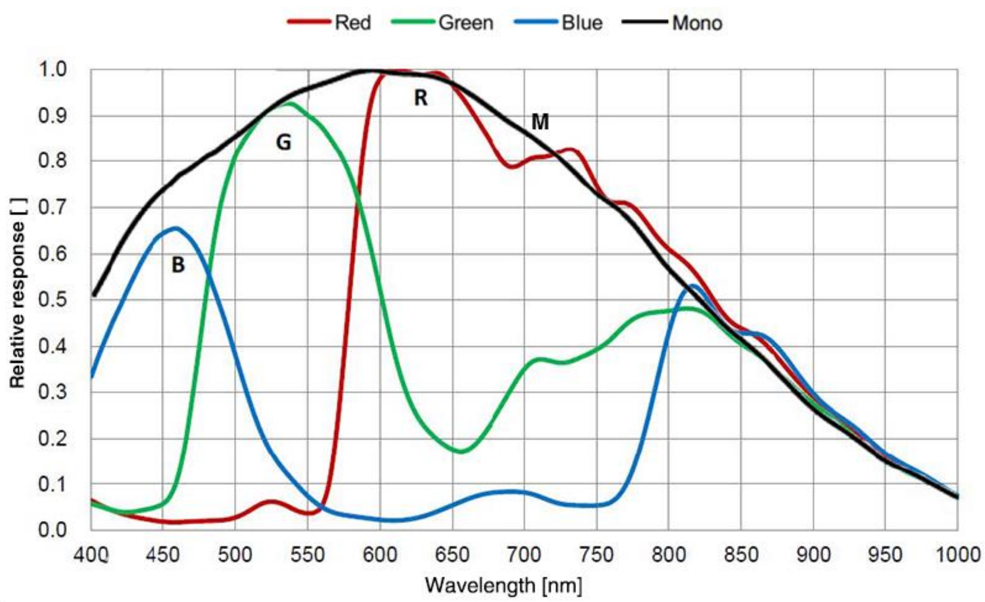


Figure 4-11 MER2-301-125U3M/C(-L) sensor spectral response

4.2.12. MER2-302-56U3M/C(-L)

Specifications	MER2-302-56U3C MER2-302-56U3C-L	MER2-302-56U3M MER2-302-56U3M-L
Resolution	2048 × 1536	
Sensor	Sony IMX265 global shutter CMOS	
Max. Image Circle	1/1.8 inch	
Pixel Size	3.45μm × 3.45μm	
Frame Rate	56fps@2048 × 1536	
ADC Bit Depth	12bit	
Pixel Bit Depth	8bit, 10bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer RG8/Bayer RG10	Mono8/Mono10
Signal Noise Ratio	40.09dB	40.76dB
Exposure Time	UltraShort: 1μs~100μs, Actual Steps: 1μs Standard: 20μs~1s, Actual Steps: 1 row period	
Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB	
Binning	1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4	
Decimation	Sensor: 1×1, 2×2	
Synchronization	Hardware trigger (MER2-U3-L: N/A), software trigger	
I/O	1 input and 1 output with opto-isolated, 2 programmable GPIOs (MER2-U3-L: N/A)	
Operating Temp.	0°C~45°C	
Storage Temp.	-20°C~70°C	
Operating Humidity	10%~80%	
Typical Power	1.91W@5V	
Power Requirements	Power over USB3.0	
Lens Mount	C	
Data Interface	USB3.0	
Dimensions	29mm×29mm×29mm (without lens adapter or connectors)	
Weight	MER2-U3: 65g, MER2-U3-L: 61g	
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8	

Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity (MER2-U3-L not support trigger polarity and flash polarity)
Conformity	CE, RoHS, FCC, ICES, UKCA, UL, USB3 Vision, GenICam

Table 4-12 MER2-302-56U3M/C(-L) camera specifications

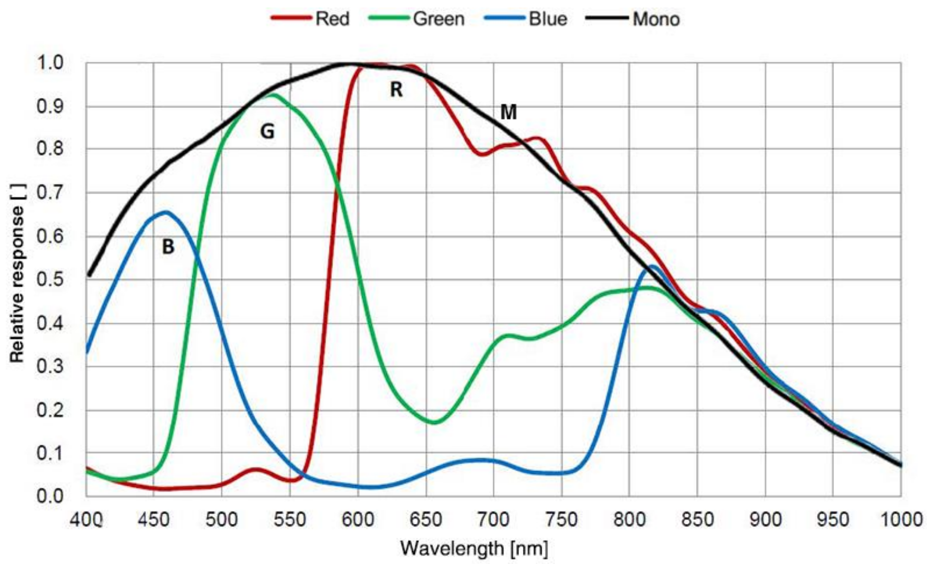


Figure 4-12 MER2-302-56U3M/C(-L) sensor spectral response

4.2.13. MER2-303-107U3M/C(-L)

Specifications	MER2-303-107U3C MER2-303-107U3C-L	MER2-303-107U3M MER2-303-107U3M-L
Resolution	2048 × 1536	
Sensor	Sony global shutter CMOS	
Max. Image Circle	1/1.8 inch	
Pixel Size	3.45μm × 3.45μm	
Frame Rate	107.6fps@2048 × 1536	
ADC Bit Depth	12bit	
Pixel Bit Depth	8bit, 12bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer RG8/Bayer RG12	Mono8/Mono12
Signal Noise Ratio	40.56dB	40.62dB
Exposure Time	UltraShort: 1μs~100μs, Actual Steps: 1μs Standard: 20μs~1s, Actual Steps: 1 row period	
Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB	

Binning	FPGA: 1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4 Sensor: 1×1, 2×2 (only mono models)
Decimation	FPGA: 1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4
Synchronization	Hardware trigger (MER2-U3-L: N/A), software trigger
I/O	1 input and 1 output with opto-isolated, 2 programmable GPIOs (MER2-U3-L: N/A)
Operating Temp.	0°C~45°C
Storage Temp.	-20°C~70°C
Operating Humidity	10%~80%
Typical Power	2.59W@5V
Power Requirements	Power over USB3.0
Lens Mount	C
Data Interface	USB3.0
Dimensions	29mm×29mm×29mm (without lens adapter or connectors)
Weight	MER2-U3: 65g, MER2-U3-L: 61g
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8
Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity (MER2-U3-L not support trigger polarity and flash polarity)
Conformity	CE, RoHS, FCC, ICES, UKCA, UL, USB3 Vision, GenICam

Table 4-13 MER2-303-107U3M/C(-L) camera specifications

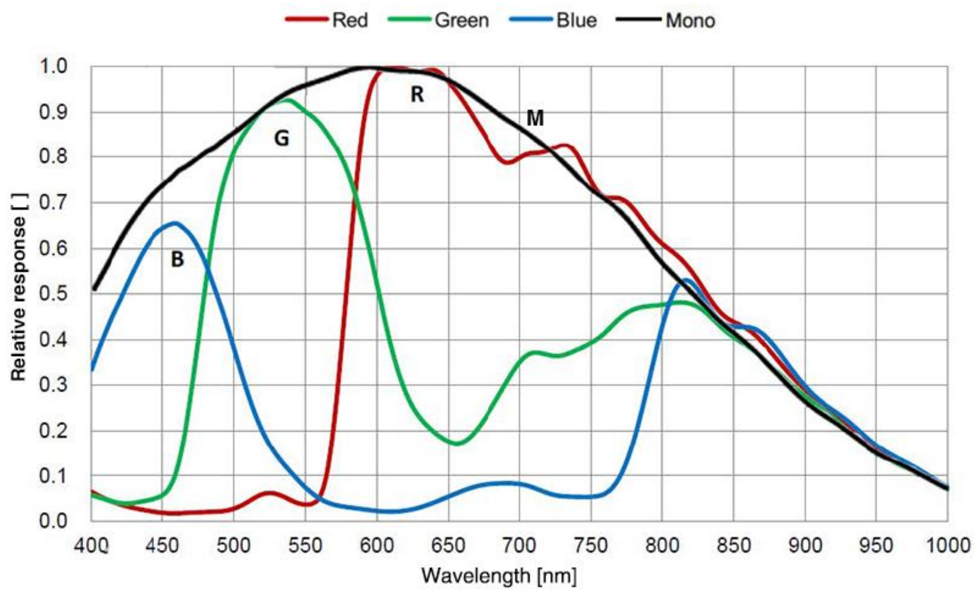


Figure 4-13 MER2-303-107U3M/C(-L) sensor spectral response

4.2.14. MER2-304-56U3M/C(-L)

Specifications	MER2-304-56U3C MER2-304-56U3C-L	MER2-304-56U3M MER2-304-56U3M-L
Resolution	2048 × 1536	
Sensor	Sony global shutter CMOS	
Max. Image Circle	1/1.8 inch	
Pixel Size	3.45μm × 3.45μm	
Frame Rate	56.2fps@2048 × 1536	
ADC Bit Depth	12bit	
Pixel Bit Depth	8bit, 12bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer RG8/Bayer RG12	Mono8/Mono12
Signal Noise Ratio	40.56dB	40.62dB
Exposure Time	UltraShort: 1μs~100μs, Actual Steps: 1μs Standard: 20μs~1s, Actual Steps: 1 row period	
Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB	
Binning	FPGA: 1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4 Sensor: 1×1, 2×2 (only mono models)	
Decimation	FPGA: 1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4	
Synchronization	Hardware trigger (MER2-U3-L: N/A), software trigger	
I/O	1 input and 1 output with opto-isolated, 2 programmable GPIOs (MER2-U3-L: N/A)	
Operating Temp.	0°C~45°C	
Storage Temp.	-20°C~70°C	
Operating Humidity	10%~80%	
Typical Power	2.59W@5V	
Power Requirements	Power over USB3.0	
Lens Mount	C	
Data Interface	USB3.0	
Dimensions	29mm×29mm×29mm (without lens adapter or connectors)	
Weight	MER2-U3: 65g, MER2-U3-L: 61g	

Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8
Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity (MER2-U3-L not support trigger polarity and flash polarity)
Conformity	CE, RoHS, FCC, ICES, UKCA, UL, USB3 Vision, GenICam

Table 4-14 MER2-304-56U3M/C(-L) camera specifications

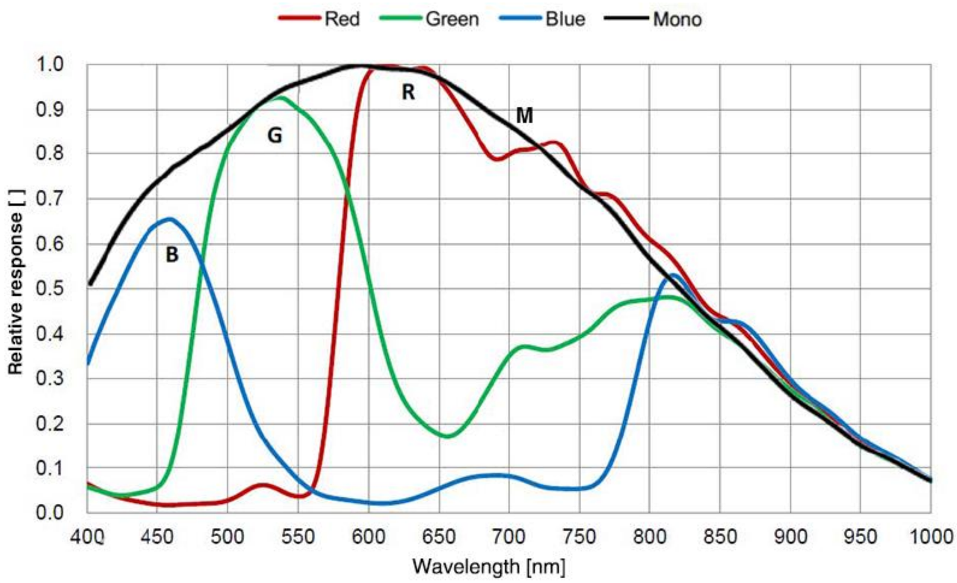


Figure 4-14 MER2-304-56U3M/C(-L) sensor spectral response

4.2.15. MER2-501-79U3M/C(-L)

Specifications	MER2-501-79U3C MER2-501-79U3C-L	MER2-501-79U3M MER2-501-79U3M-L
Resolution	2448 × 2048	
Sensor	Sony global shutter CMOS	
Max. Image Circle	2/3 inch	
Pixel Size	3.45μm × 3.45μm	
Frame Rate	78.9fps@2448 × 2048	
ADC Bit Depth	12bit	
Pixel Bit Depth	8bit, 12bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer RG8/Bayer RG12	Mono8/Mono12
Signal Noise Ratio	40.56dB	40.62dB
Exposure Time	UltraShort: 1μs~100μs, Actual Steps: 1μs Standard: 20μs~1s, Actual Steps: 1 row period	

Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB
Binning	1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4
Decimation	FPGA: 1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4 Sensor: 1×1, 2×2
Synchronization	Hardware trigger (MER2-U3-L: N/A), software trigger
I/O	1 input and 1 output with opto-isolated, 2 programmable GPIOs (MER2-U3-L: N/A)
Operating Temp.	0°C~45°C
Storage Temp.	-20°C~70°C
Operating Humidity	10%~80%
Typical Power	2.59W@5V
Power Requirements	Power over USB3.0
Lens Mount	C
Data Interface	USB3.0
Dimensions	29mm×29mm×29mm (without lens adapter or connectors)
Weight	MER2-U3: 65g, MER2-U3-L: 61g
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8
Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity (MER2-U3-L not support trigger polarity and flash polarity)
Conformity	CE, RoHS, FCC, ICES, UKCA, UL, USB3 Vision, GenICam

Table 4-15 MER2-501-79U3M/C(-L) camera specifications

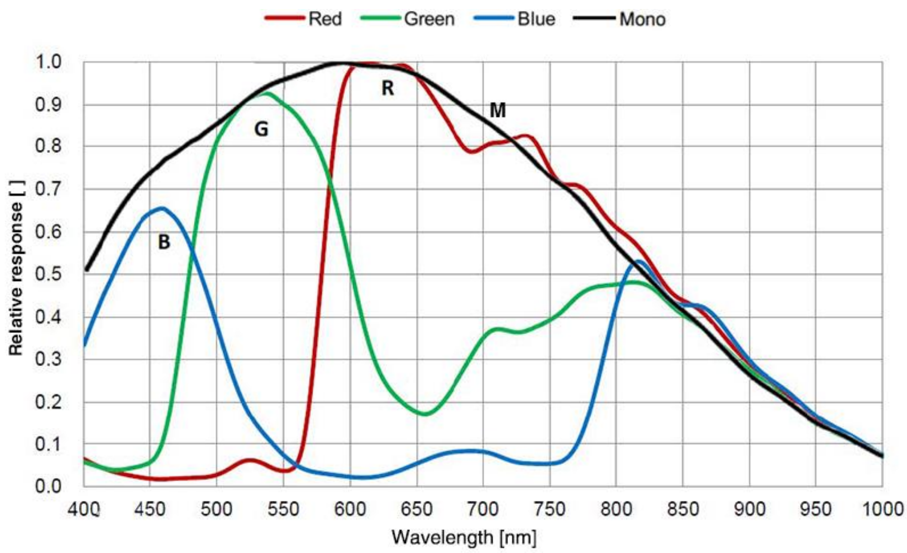


Figure 4-15 MER2-501-79U3M/C(-L) sensor spectral response

4.2.16. MER2-502-79U3M/C(-L)

Specifications	MER2-502-79U3C MER2-502-79U3C-L	MER2-502-79U3M MER2-502-79U3M-L
Resolution	2448 × 2048	
Sensor	Sony IMX250 global shutter CMOS	
Max. Image Circle	2/3 inch	
Pixel Size	3.45μm × 3.45μm	
Frame Rate	79.1fps@2448 × 2048	
ADC Bit Depth	10bit	
Pixel Bit Depth	8bit, 10bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer RG8/Bayer RG10	Mono8/Mono10
Signal Noise Ratio	40.58dB	40.65dB
Exposure Time	UltraShort: 1μs~100μs, Actual Steps: 1μs Standard: 20μs~1s, Actual Steps: 1 row period	
Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB	
Binning	1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4	
Decimation	FPGA: 1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4 Sensor: 1×1, 2×2	
Synchronization	Hardware trigger (MER2-U3-L: N/A), software trigger	
I/O	1 input and 1 output with opto-isolated, 2 programmable GPIOs (MER2-U3-L: N/A)	
Operating Temp.	0°C~45°C	
Storage Temp.	-20°C~70°C	
Operating Humidity	10%~80%	
Typical Power	2.76W@5V	
Power Requirements	Power over USB3.0	
Lens Mount	C	
Data Interface	USB3.0	
Dimensions	29mm×29mm×29mm (without lens adapter or connectors)	
Weight	MER2-U3: 65g, MER2-U3-L: 61g	
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8	

Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity (MER2-U3-L not support trigger polarity and flash polarity)
Conformity	CE, RoHS, FCC, ICES, UKCA, UL, USB3 Vision, GenICam

Table 4-16 MER2-502-79U3M/C(-L) camera specifications

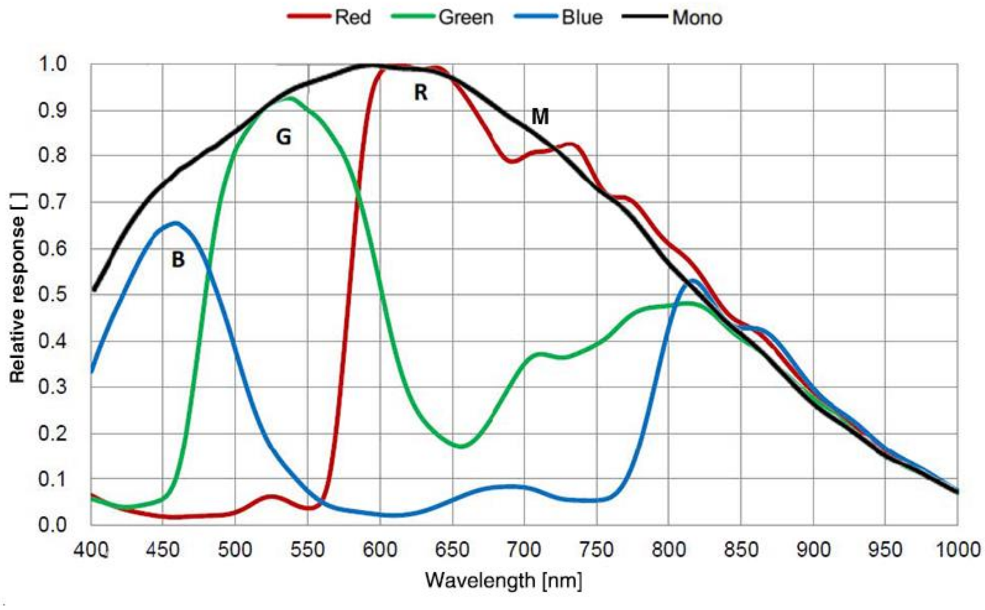


Figure 4-16 MER2-502-79U3M/C(-L) sensor spectral response

4.2.17. MER2-502-79U3M POL

Specifications	MER2-502-79U3M POL
Resolution	2448 × 2048
Sensor	Sony IMX250 MZR global shutter CMOS
Max. Image Circle	2/3 inch
Pixel Size	3.45μm × 3.45μm
Frame Rate	79.1fps @ 2448 × 2048
ADC Bit Depth	10bit
Pixel Bit Depth	8bit, 10bit
Mono/Color	Mono polarization
Pixel Formats	Mono8/Mono10
Signal Noise Ratio	40.65dB
Exposure Time	UltraShort: 1μs~100μs, Actual Steps: 1μs Standard: 20μs~1s, Actual Steps: 1 row period

Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB
Binning	1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4
Decimation	FPGA: 1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4 Sensor: 1×1, 2×2
Synchronization	Hardware trigger, software trigger
I/O	1 input and 1 output with opto-isolated, 2 programmable GPIOs
Operating Temp.	0°C~45°C
Storage Temp.	-20°C~70°C
Operating Humidity	10%~80%
Typical Power	2.76W@5V
Power Requirements	Power over USB3.0
Lens Mount	C
Data Interface	USB3.0
Dimensions	29mm×29mm×29mm (without lens adapter or connectors)
Weight	65g
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8
Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity
Conformity	CE, RoHS, FCC, ICES, UKCA, UL, USB3 Vision, GenICam

Table 4-17 MER2-502-79U3M POL camera specifications

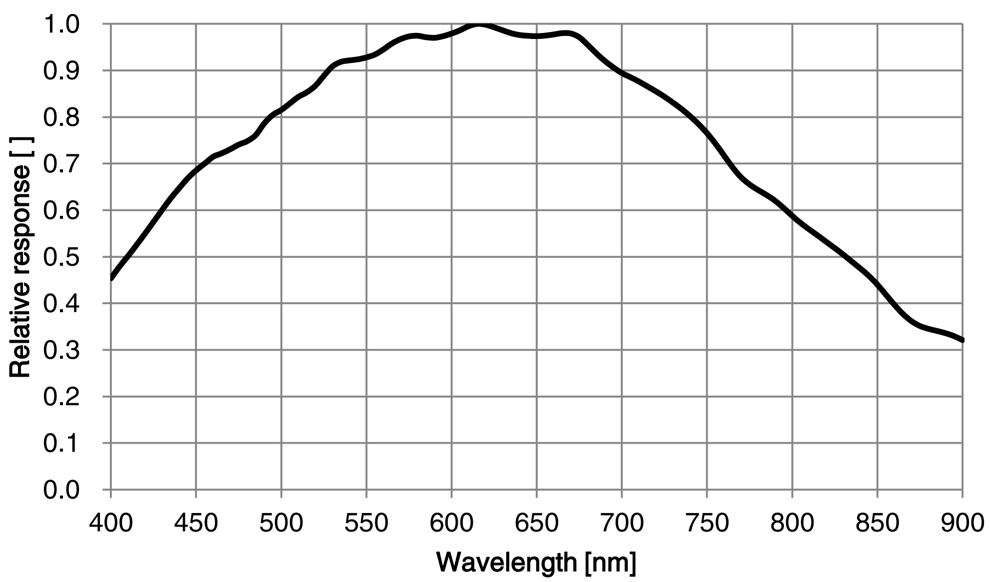


Figure 4-17 MER2-502-79U3M POL sensor spectral response

4.2.18. MER2-503-36U3M/C(-L)

Specifications	MER2-503-36U3C MER2-503-36U3C-L	MER2-503-36U3M MER2-503-36U3M-L
Resolution	2448 × 2048	
Sensor	Sony IMX264 global shutter CMOS	
Max. Image Circle	2/3 inch	
Pixel Size	3.45μm × 3.45μm	
Frame Rate	36fps@2448 × 2048	
ADC Bit Depth	12bit	
Pixel Bit Depth	8bit, 10bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer RG8/Bayer RG10	Mono8/Mono10
Signal Noise Ratio	40.5dB	40.4dB
Exposure Time	UltraShort: 1μs~100μs, Actual Steps: 1μs Standard: 20μs~1s, Actual Steps: 1 row period	
Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB	
Binning	1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4	
Decimation	FPGA: 1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4 Sensor: 1×1, 2×2	
Synchronization	Hardware trigger (MER2-U3-L: N/A), software trigger	
I/O	1 input and 1 output with opto-isolated, 2 programmable GPIOs (MER2-U3-L: N/A)	
Operating Temp.	0°C~45°C	
Storage Temp.	-20°C~70°C	
Operating Humidity	10%~80%	
Typical Power	1.75W@5V	
Power Requirements	Power over USB3.0	
Lens Mount	C	
Data Interface	USB3.0	
Dimensions	29mm×29mm×29mm (without lens adapter or connectors)	
Weight	MER2-U3: 65g, MER2-U3-L: 61g	
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8	

Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity (MER2-U3-L not support trigger polarity and flash polarity)
Conformity	CE, RoHS, FCC, ICES, UKCA, UL, USB3 Vision, GenICam

Table 4-18 MER2-503-36U3M/C(-L) camera specifications

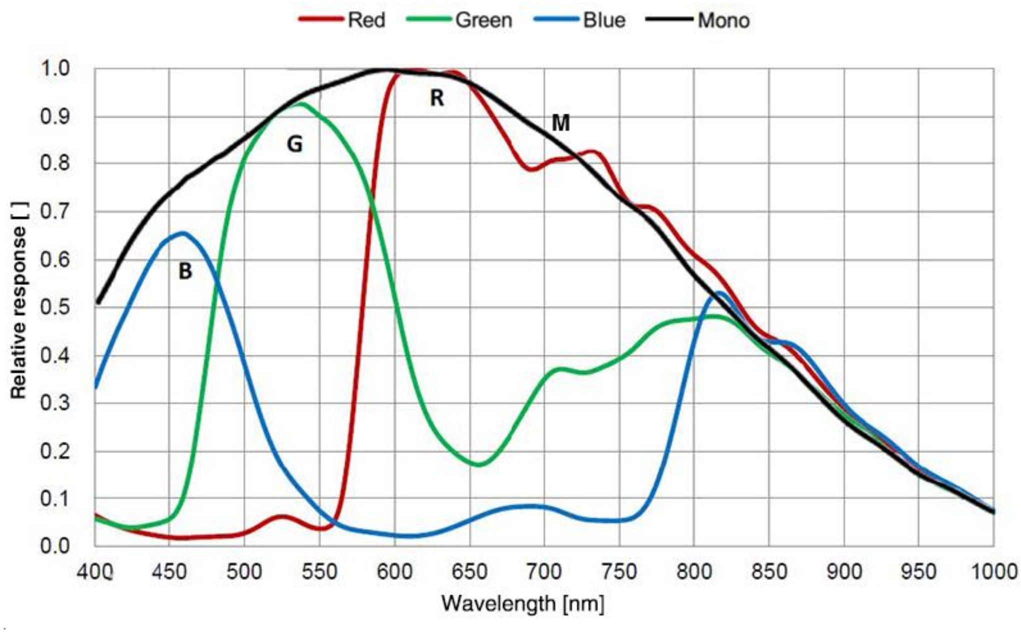


Figure 4-18 MER2-503-36U3M/C(-L) sensor spectral response

4.2.19. MER2-503-36U3M POL

Specifications	MER2-503-36U3M POL
Resolution	2448 × 2048
Sensor	Sony IMX264 MZR global shutter CMOS
Max. Image Circle	2/3 inch
Pixel Size	3.45μm × 3.45μm
Frame Rate	36fps@2448 × 2048
ADC Bit Depth	12bit
Pixel Bit Depth	8bit, 10bit
Mono/Color	Mono polarization
Pixel Formats	Mono8/Mono10
Signal Noise Ratio	40.6dB
Exposure Time	UltraShort: 1μs~100μs, Actual Steps: 1μs Standard: 20μs~1s, Actual Steps: 1 row period
Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB

Binning	1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4
Decimation	FPGA: 1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4 Sensor: 1×1, 2×2
Synchronization	Hardware trigger, software trigger
I/O	1 input and 1 output with opto-isolated, 2 programmable GPIOs
Operating Temp.	0°C~45°C
Storage Temp.	-20°C~70°C
Operating Humidity	10%~80%
Typical Power	1.75W@5V
Power Requirements	Power over USB3.0
Lens Mount	C
Data Interface	USB3.0
Dimensions	29mm×29mm×29mm (without lens adapter or connectors)
Weight	65g
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8
Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity
Conformity	CE, RoHS, FCC, ICES, UKCA, UL, USB3 Vision, GenICam

Table 4-19 MER2-503-36U3M POL camera specifications

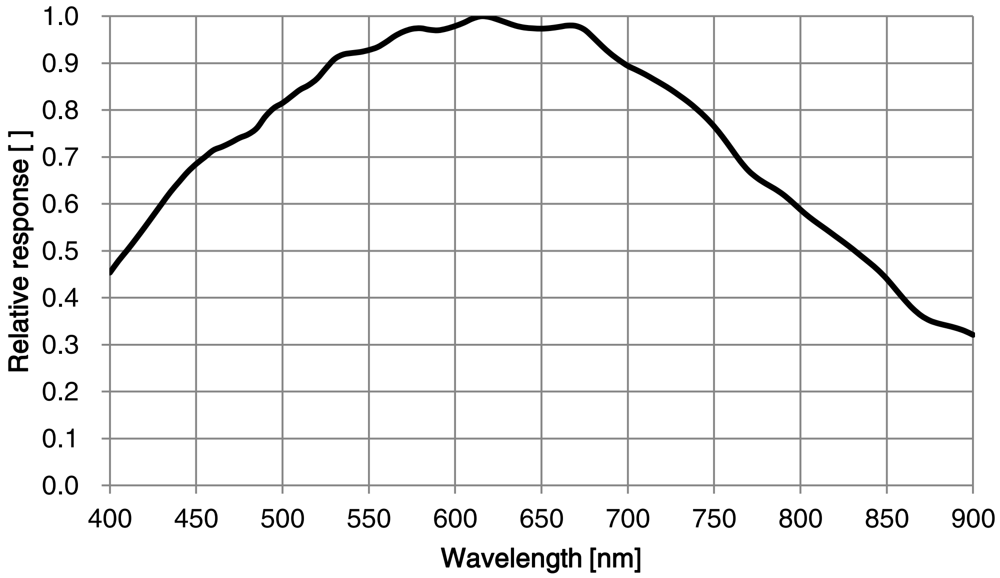


Figure 4-19 MER2-503-36U3M POL sensor spectral response

4.2.20. MER2-510-36U3M/C(-L)

Specifications	MER2-510-36U3C MER2-510-36U3C-L	MER2-510-36U3M MER2-510-36U3M-L
Resolution	2448 × 2048	
Sensor	Sony global shutter CMOS	
Max. Image Circle	2/3 inch	
Pixel Size	3.45μm × 3.45μm	
Frame Rate	36fps@2448 × 2048	
ADC Bit Depth	12bit	
Pixel Bit Depth	8bit, 12bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer RG8/Bayer RG12	Mono8/Mono12
Signal Noise Ratio	40.56dB	40.62dB
Exposure Time	UltraShort: 1μs~100μs, Actual Steps: 1μs Standard: 20μs~1s, Actual Steps: 1 row period	
Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB	
Binning	1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4	
Decimation	FPGA: 1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4 Sensor: 1×1, 2×2	
Synchronization	Hardware trigger (MER2-U3-L: N/A), software trigger	
I/O	1 input and 1 output with opto-isolated, 2 programmable GPIOs (MER2-U3-L: N/A)	
Operating Temp.	0°C~45°C	
Storage Temp.	-20°C~70°C	
Operating Humidity	10%~80%	
Typical Power	2.59W@5V	
Power Requirements	Power over USB3.0	
Lens Mount	C	
Data Interface	USB3.0	
Dimensions	29mm×29mm×29mm (without lens adapter or connectors)	
Weight	MER2-U3: 65g, MER2-U3-L: 61g	
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8	

Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity (MER2-U3-L not support trigger polarity and flash polarity)
Conformity	CE, RoHS, FCC, ICES, UKCA, UL, USB3 Vision, GenICam

Table 4-20 MER2-510-36U3M/C(-L) camera specifications

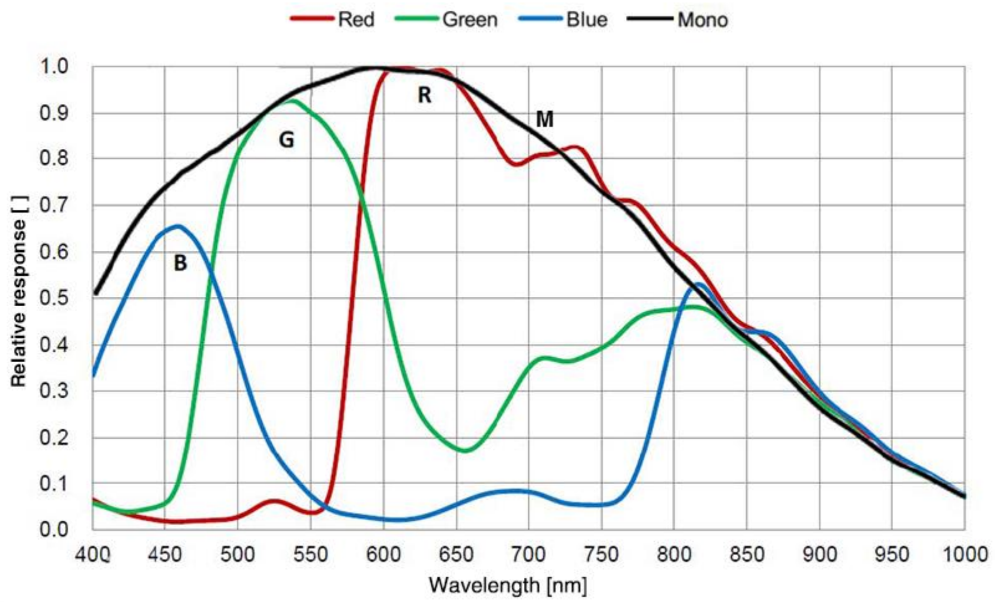


Figure 4-20 MER2-510-36U3M/C(-L) sensor spectral response

4.2.21. MER2-630-60U3M/C(-L/-W90/-W90-S90)

Specifications	MER2-630-60U3C MER2-630-60U3C-L MER2-630-60U3C-W90 MER2-630-60U3C-W90-S90	MER2-630-60U3M MER2-630-60U3M-L MER2-630-60U3M-W90 MER2-630-60U3M-W90-S90
Resolution	3088 × 2064	
Sensor	Sony IMX178 rolling shutter CMOS	
Max. Image Circle	1/1.8 inch	
Pixel Size	2.4μm × 2.4μm	
Frame Rate	60fps@3088 × 2064	
ADC Bit Depth	10bit	
Pixel Bit Depth	8bit, 10bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer RG8/Bayer RG10	Mono8/Mono10
Signal Noise Ratio	40.19dB	40.18dB
Exposure Time	Standard: 8μs~1s, Actual Steps: 1 row period	

Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB
Binning	1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4
Decimation	FPGA: 1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4
Synchronization	Hardware trigger (MER2-U3-L: N/A), software trigger
I/O	1 input and 1 output with opto-isolated, 2 programmable GPIOs (MER2-U3-L: N/A)
Operating Temp.	0°C~45°C
Storage Temp.	-20°C~70°C
Operating Humidity	10%~80%
Typical Power	1.82W@5V
Power Requirements	Power over USB3.0
Lens Mount	C
Data Interface	USB3.0
Dimensions	MER2-U3(-L): 29mm×29mm×29mm (without lens adapter or connectors) MER2-U3-W90(-S90): 29mm×29mm×58.8mm (with lens adapter, without I/O connectors)
Weight	MER2-U3: 65g, MER2-U3-L: 61g, MER2-U3-W90(-S90): 78g
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8
Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity (MER2-U3-L not support trigger polarity and flash polarity)
Conformity	CE, RoHS, FCC, ICES, UKCA, UL(-W90(-S90): N/A), USB3 Vision, GenICam

Table 4-21 MER2-630-60U3M/C(-L/-W90/-W90-S90) camera specifications

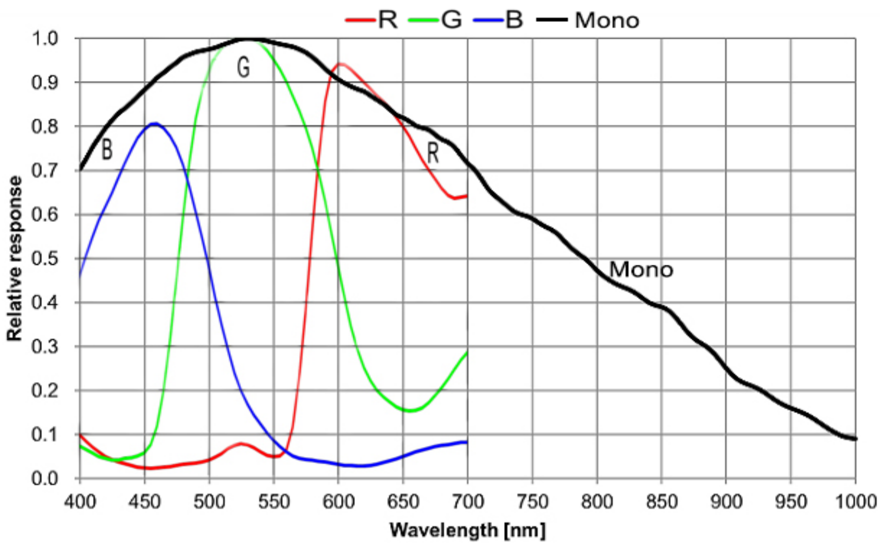


Figure 4-21 MER2-630-60U3M/C(-L/-W90/-W90-S90) sensor spectral response

4.2.22. MER2-1220-32U3M/C(-L/-W90/-W90-S90)

Specifications	MER2-1220-32U3C MER2-1220-32U3C-L MER2-1220-32U3C-W90 MER2-1220-32U3C-W90-S90	MER2-1220-32U3M MER2-1220-32U3M-L MER2-1220-32U3M-W90 MER2-1220-32U3M-W90-S90
Resolution	4024 × 3036	
Sensor	Sony IMX226 rolling shutter CMOS	
Max. Image Circle	1/1.7 inch	
Pixel Size	1.85μm × 1.85μm	
Frame Rate	32.3fps@4024 × 3036	
ADC Bit Depth	12bit	
Pixel Bit Depth	8bit, 12bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer RG8/Bayer RG12	Mono8/Mono12
Signal Noise Ratio	40.61dB	40.77dB
Exposure Time	Standard: 10μs~1s, Actual Steps: 1 row period	
Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB	
Binning	1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4	
Decimation	FPGA: 1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4	
Synchronization	Hardware trigger (MER2-U3-L: N/A), software trigger	
I/O	1 input and 1 output with opto-isolated, 2 programmable GPIOs (MER2-U3-L: N/A)	
Operating Temp.	0°C~45°C	
Storage Temp.	-20°C~70°C	
Operating Humidity	10%~80%	
Typical Power	1.79W@5V	
Power Requirements	Power over USB3.0	
Lens Mount	C	
Data Interface	USB3.0	
Dimensions	MER2-U3(-L): 29mm×29mm×29mm (without lens adapter or connectors) MER2-U3-W90(-S90): 29mm×29mm×58.8mm (with lens adapter, without I/O connectors)	
Weight	MER2-U3: 65g, MER2-U3-L: 61g, MER2-U3-W90(-S90): 78g	
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8	

Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity (MER2-U3-L not support trigger polarity and flash polarity)
Conformity	CE, RoHS, FCC, ICES, UKCA, UL(-W90(-S90): N/A), USB3 Vision, GenICam

Table 4-22 MER2-1220-32U3M/C(-L/-W90/-W90-S90) camera specifications

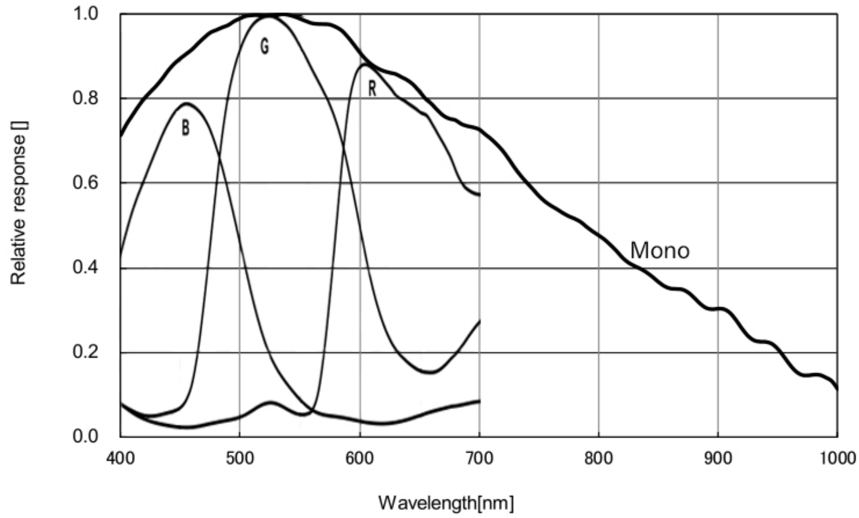


Figure 4-22 MER2-1220-32U3M/C(-L/-W90/-W90-S90) sensor spectral response

4.2.23. MER2-2000-19U3M/C(-L/-W90/-W90-S90)

Specifications	MER2-2000-19U3C MER2-2000-19U3C-L MER2-2000-19U3C-W90 MER2-2000-19U3C-W90-S90	MER2-2000-19U3M MER2-2000-19U3M-L MER2-2000-19U3M-W90 MER2-2000-19U3M-W90-S90
Resolution	5496 × 3672	
Sensor	Sony IMX183 rolling shutter CMOS	
Max. Image Circle	1 inch	
Pixel Size	2.4μm × 2.4μm	
Frame Rate	19.6fps@5496 × 3672	
ADC Bit Depth	12bit	
Pixel Bit Depth	8bit, 12bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer RG8/Bayer RG12	Mono8/Mono12
Signal Noise Ratio	41.56dB	42.08dB
Exposure Time	Standard: 12μs~1s, Actual Steps: 1 row period	
Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB	

Binning	FPGA: 1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4 Sensor: 1×1, 2×2
Decimation	FPGA: 1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4
Synchronization	Hardware trigger (MER2-U3-L: N/A), software trigger
I/O	1 input and 1 output with opto-isolated, 2 programmable GPIOs (MER2-U3-L: N/A)
Operating Temp.	0°C~45°C
Storage Temp.	-20°C~70°C
Operating Humidity	10%~80%
Typical Power	2.00W@5V
Power Requirements	Power over USB3.0
Lens Mount	C
Data Interface	USB3.0
Dimensions	MER2-U3(-L): 29mm×29mm×29mm (without lens adapter or connectors) MER2-U3-W90(-S90): 29mm×29mm×58.8mm (with lens adapter, without I/O connectors)
Weight	MER2-U3: 65g, MER2-U3-L: 61g, MER2-U3-W90(-S90): 78g
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8
Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity (MER2-U3-L not support trigger polarity and flash polarity)
Conformity	CE, RoHS, FCC, ICES, UKCA, UL(-W90(-S90): N/A), USB3 Vision, GenICam

Table 4-23 MER2-2000-19U3M/C(-L/-W90/-W90-S90) camera specifications

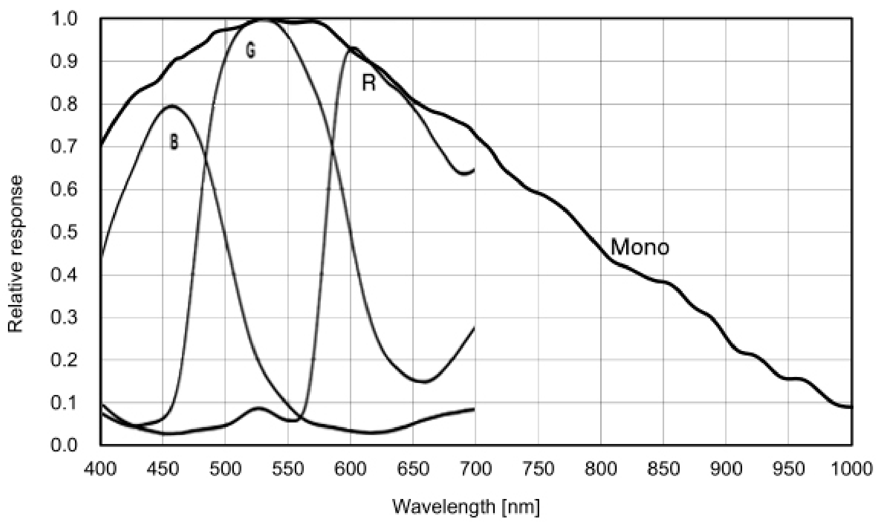


Figure 4-23 MER2-2000-19U3M/C(-L/-W90/-W90-S90) sensor spectral response

4.2.24. MER2-2002-20U3M/C(-L)

Specifications	MER2-2002-20U3C MER2-2002-20U3C-L	MER2-2002-20U3M MER2-2002-20U3M-L
Resolution	5120 × 3840	
Sensor	Onsemi AR2020 rolling shutter CMOS	
Max. Image Circle	1/1.8 inch	
Pixel Size	1.4μm × 1.4μm	
Frame Rate	20.7fps@5120× 3840	
ADC Bit Depth	10bit	
Pixel Bit Depth	8bit, 10bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer GR8/Bayer GR10	Mono8/Mono10
Signal Noise Ratio	39.27dB	39.41dB
Exposure Time	Standard: 26μs~1s, Actual Steps: 1 row period	
Gain	0dB~24dB, Default: 0dB, Steps: 0.375dB	
Binning	FPGA: 1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4 Sensor: 1×1, 2×2, 4×4	
Decimation	Sensor: 1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4	
Synchronization	Hardware trigger (MER2-U3-L: N/A), software trigger	
I/O	1 input and 1 output with opto-isolated, 2 programmable GPIOs (MER2-U3-L: N/A)	
Operating Temp.	0°C~45°C	
Storage Temp.	-20°C~70°C	
Operating Humidity	10%~80%	
Typical Power	2.00W@5V	
Power Requirements	Power over USB3.0	
Lens Mount	C	
Data Interface	USB3.0	
Dimensions	29mm×29mm×29mm (without lens adapter or connectors)	
Weight	MER2-U3: 65g, MER2-U3-L: 61g	
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8	

Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity (MER2-U3-L not support trigger polarity and flash polarity)
Conformity	CE, RoHS, FCC, ICES, UKCA, UL, USB3 Vision, GenICam

Table 4-24 MER2-2002-20U3M/C(-L) camera specifications

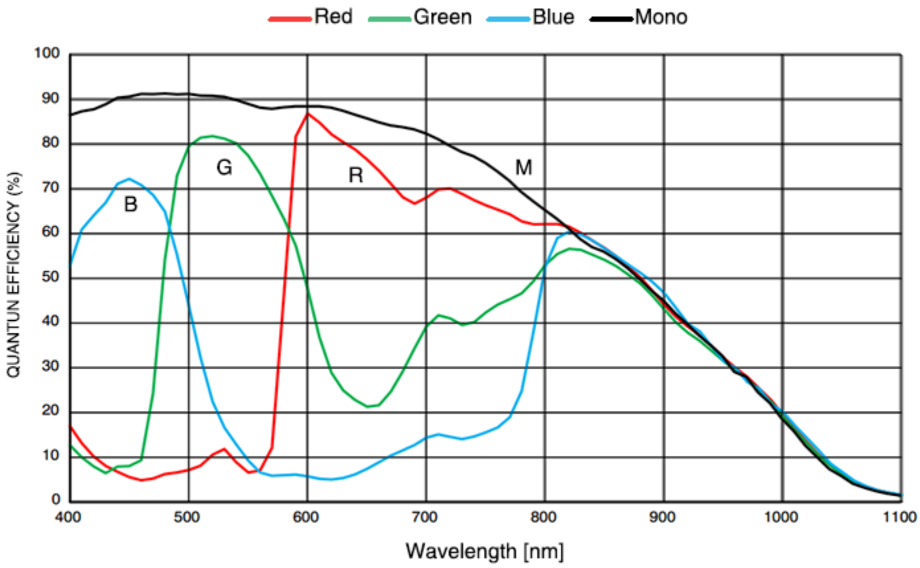


Figure 4-24 MER2-2002-20U3M/C(-L) sensor spectral response

4.2.25. MER2-041-608U3M/C(-L)-HS

Specifications	MER2-041-608U3C-HS MER2-041-608U3C-L-HS	MER2-041-608U3M-HS MER2-041-608U3M-L-HS
Resolution	720 × 540	
Sensor	Sony IMX287 global shutter CMOS	
Max. Image Circle	1/2.9 inch	
Pixel Size	6.9μm × 6.9μm	
Frame Rate	608fps@720 × 540	
ADC Bit Depth	8bit, 10bit, 12bit	
Pixel Bit Depth	8bit, 10bit, 12bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer RG8/Bayer RG10/Bayer RG12	Mono8/Mono10/Mono12
Signal Noise Ratio	43.3dB	43.3dB
Exposure Time	UltraShort: 1μs~100μs, Actual Steps: 1μs Standard: 20μs~1s, Actual Steps: 1 row period	

Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB
Binning	1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4
Decimation	FPGA: 1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4
Synchronization	Hardware trigger (MER2-U3-L: N/A), software trigger
I/O	1 input and 1 output with opto-isolated, 2 programmable GPIOs (MER2-U3-L: N/A)
Operating Temp.	0°C~45°C
Storage Temp.	-20°C~70°C
Operating Humidity	10%~80%
Typical Power	1.66W@5V
Power Requirements	Power over USB3.0
Lens Mount	C
Data Interface	USB3.0
Dimensions	29mm×29mm×29mm (without lens adapter or connectors)
Weight	MER2-U3: 65g, MER2-U3-L: 61g
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8
Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity (MER2-U3-L not support trigger polarity and flash polarity)
Conformity	CE, RoHS, FCC, ICES, UKCA, UL, USB3 Vision, GenICam

Table 4-25 MER2-041-608U3M/C(-L)-HS camera specifications

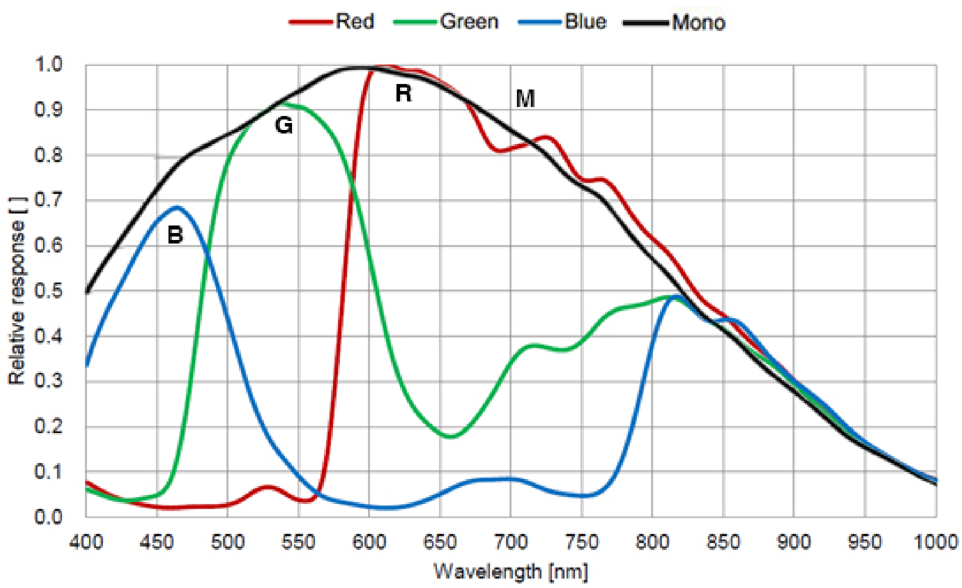


Figure 4-25 MER2-041-608U3M/C(-L)-HS sensor spectral response

4.2.26. MER2-160-249U3M/C(-L)-HS

Specifications	MER2-160-249U3C-HS MER2-160-249U3C-L-HS	MER2-160-249U3M-HS MER2-160-249U3M-L-HS
Resolution	1440 × 1080	
Sensor	Sony IMX273 global shutter CMOS	
Max. Image Circle	1/2.9 inch	
Pixel Size	3.45μm × 3.45μm	
Frame Rate	249.2fps@1440 × 1080	
ADC Bit Depth	8bit, 10bit, 12bit	
Pixel Bit Depth	8bit, 10bit, 12bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer RG8/Bayer RG10/Bayer RG12	Mono8/Mono10/Mono12
Signal Noise Ratio	40.5dB	40.5dB
Exposure Time	UltraShort: 1μs~100μs, Actual Steps: 1μs Standard: 20μs~1s, Actual Steps: 1 row period	
Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB	
Binning	1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4	
Decimation	Sensor: 1×1, 2×2	
Synchronization	Hardware trigger (MER2-U3-L: N/A), software trigger	
I/O	1 input and 1 output with opto-isolated, 2 programmable GPIOs (MER2-U3-L: N/A)	
Operating Temp.	0°C~45°C	
Storage Temp.	-20°C~70°C	
Operating Humidity	10%~80%	
Typical Power	2.33W@5V	
Power Requirements	Power over USB3.0	
Lens Mount	C	
Data Interface	USB3.0	
Dimensions	29mm×29mm×29mm (without lens adapter or connectors)	
Weight	MER2-U3: 65g, MER2-U3-L: 61g	
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8	

Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity (MER2-U3-L not support trigger polarity and flash polarity)
Conformity	CE, RoHS, FCC, ICES, UKCA, UL, USB3 Vision, GenICam

Table 4-26 MER2-160-249U3M/C(-L)-HS camera specifications

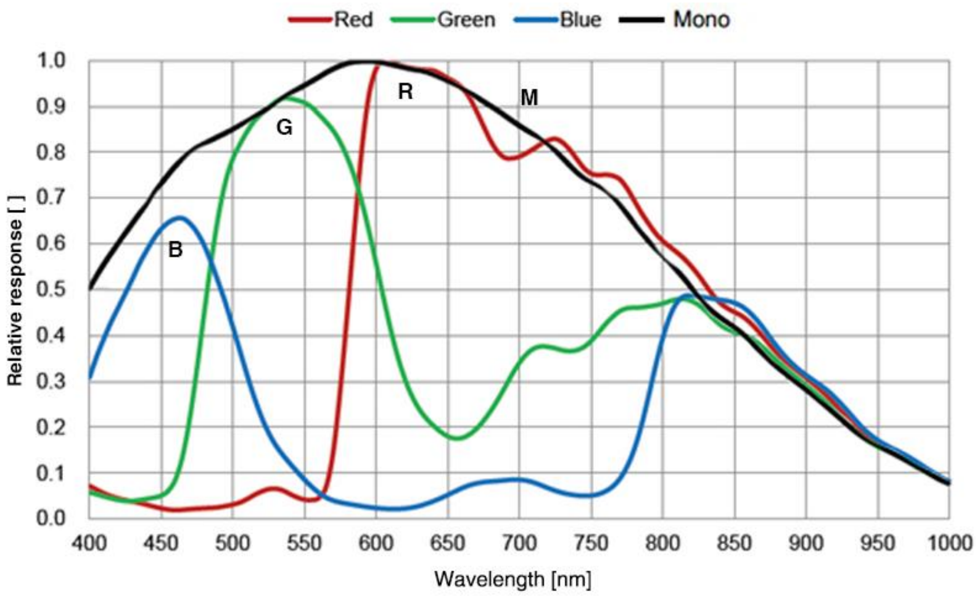


Figure 4-26 MER2-160-249U3M/C(-L)-HS sensor spectral response

4.2.27. MER2-301-125U3M/C(-L)-HS

Specifications	MER2-301-125U3C-HS MER2-301-125U3C-L-HS	MER2-301-125U3M-HS MER2-301-125U3M-L-HS
Resolution	2048 × 1536	
Sensor	Sony IMX252 global shutter CMOS	
Max. Image Circle	1/1.8 inch	
Pixel Size	3.45μm × 3.45μm	
Frame Rate	125fps@2048 × 1536	
ADC Bit Depth	8bit, 10bit, 12bit	
Pixel Bit Depth	8bit, 10bit, 12bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer RG8/Bayer RG10/Bayer RG12	Mono8/Mono10/Mono12
Signal Noise Ratio	40.76dB	40.73dB
Exposure Time	UltraShort: 1μs~100μs, Actual Steps: 1μs Standard: 20μs~1s, Actual Steps: 1 row period	

Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB
Binning	1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4
Decimation	Sensor: 1×1, 2×2
Synchronization	Hardware trigger (MER2-U3-L: N/A), software trigger
I/O	1 input and 1 output with opto-isolated, 2 programmable GPIOs (MER2-U3-L: N/A)
Operating Temp.	0°C~45°C
Storage Temp.	-20°C~70°C
Operating Humidity	10%~80%
Typical Power	2.48W@5V
Power Requirements	Power over USB3.0
Lens Mount	C
Data Interface	USB3.0
Dimensions	29mm×29mm×29mm (without lens adapter or connectors)
Weight	MER2-U3: 65g, MER2-U3-L: 61g
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8
Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity (MER2-U3-L not support trigger polarity and flash polarity)
Conformity	CE, RoHS, FCC, ICES, UKCA, UL, USB3 Vision, GenICam

Table 4-27 MER2-301-125U3M/C(-L)-HS camera specifications

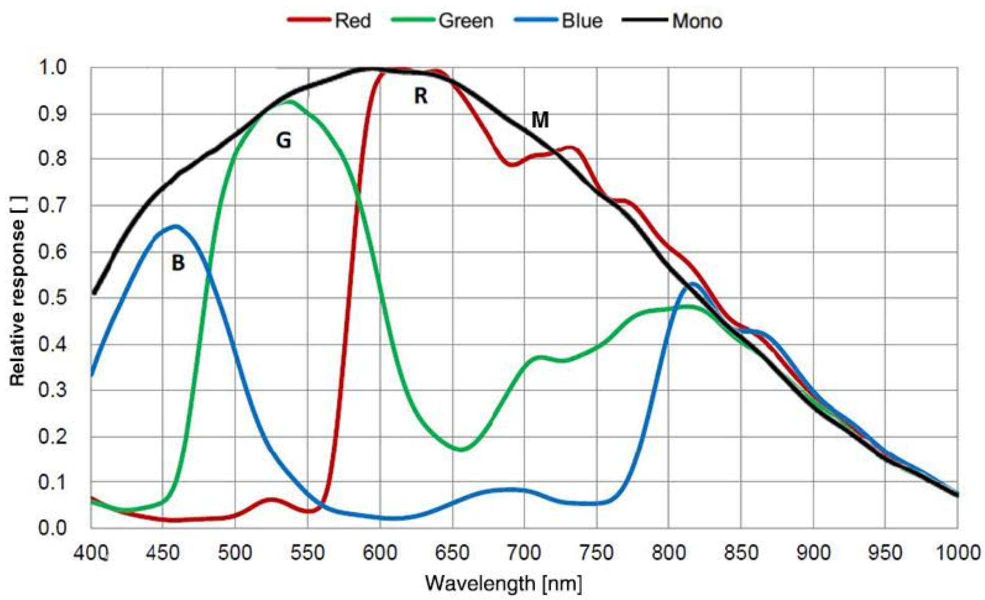


Figure 4-27 MER2-301-125U3M/C(-L)-HS sensor spectral response

4.2.28. MER2-502-79U3M/C(-L)-HS

Specifications	MER2-502-79U3C-HS MER2-502-79U3C-L-HS	MER2-502-79U3M-HS MER2-502-79U3M-L-HS
Resolution	2448 × 2048	
Sensor	Sony IMX250 global shutter CMOS	
Max. Image Circle	2/3 inch	
Pixel Size	3.45μm × 3.45μm	
Frame Rate	79.1fps@2448 × 2048	
ADC Bit Depth	10bit	
Pixel Bit Depth	8bit, 10bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer RG8/Bayer RG10	Mono8/Mono10
Signal Noise Ratio	40.81dB	40.67dB
Exposure Time	UltraShort: 1μs~100μs, Actual Steps: 1μs Standard: 20μs~1s, Actual Steps: 1 row period	
Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB	
Binning	1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4	
Decimation	FPGA: 1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4 Sensor: 1×1, 2×2	
Synchronization	Hardware trigger (MER2-U3-L: N/A), software trigger	
I/O	1 input and 1 output with opto-isolated, 2 programmable GPIOs (MER2-U3-L: N/A)	
Operating Temp.	0°C~45°C	
Storage Temp.	-20°C~70°C	
Operating Humidity	10%~80%	
Typical Power	2.44W@5V	
Power Requirements	Power over USB3.0	
Lens Mount	C	
Data Interface	USB3.0	
Dimensions	29mm×29mm×29mm (without lens adapter or connectors)	
Weight	MER2-U3: 65g, MER2-U3-L: 61g	
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8	

Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity (MER2-U3-L not support trigger polarity and flash polarity)
Conformity	CE, RoHS, FCC, ICES, UKCA, UL, USB3 Vision, GenICam

Table 4-28 MER2-502-79U3M/C(-L)-HS camera specifications

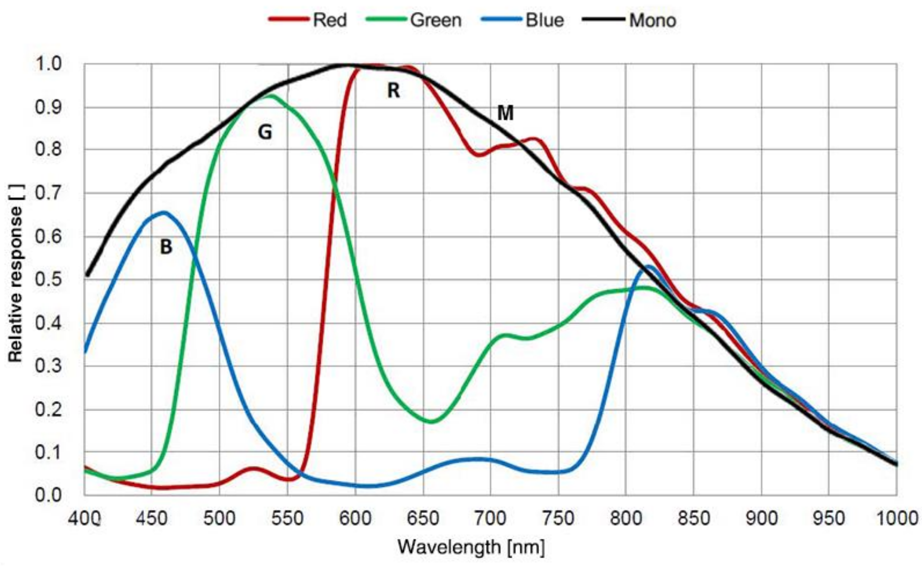


Figure 4-28 MER2-502-79U3M/C(-L)-HS sensor spectral response

4.2.29. MER2-502-79U3M-HS POL

Specifications	MER2-502-79U3M-HS POL
Resolution	2448 × 2048
Sensor	Sony IMX250 MZR global shutter CMOS
Max. Image Circle	2/3 inch
Pixel Size	3.45μm × 3.45μm
Frame Rate	79.1fps @ 2448 × 2048
ADC Bit Depth	10bit
Pixel Bit Depth	8bit, 10bit
Mono/Color	Mono polarization
Pixel Formats	Mono8/Mono10
Signal Noise Ratio	40.67dB
Exposure Time	UltraShort: 1μs~100μs, Actual Steps: 1μs Standard: 20μs~1s, Actual Steps: 1 row period
Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB

Binning	1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4
Decimation	FPGA: 1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4 Sensor: 1×1, 2×2
Synchronization	Hardware trigger, software trigger
I/O	1 input and 1 output with opto-isolated, 2 programmable GPIOs
Operating Temp.	0°C~45°C
Storage Temp.	-20°C~70°C
Operating Humidity	10%~80%
Typical Power	2.44W@5V
Power Requirements	Power over USB3.0
Lens Mount	C
Data Interface	USB3.0
Dimensions	29mm×29mm×29mm (without lens adapter or connectors)
Weight	65g
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8
Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity
Conformity	CE, RoHS, FCC, ICES, UKCA, UL, USB3 Vision, GenICam

Table 4-29 MER2-502-79U3M-HS POL camera specifications

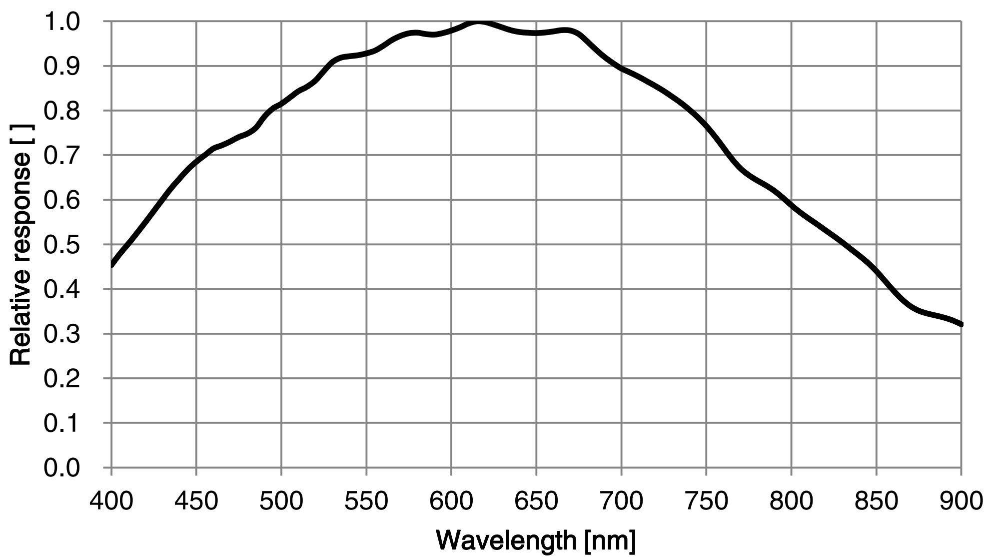


Figure 4-29 MER2-502-79U3M-HS POL sensor spectral response

4.3. MER2-U3(-L)-6P Series

4.3.1. MER2-041-608U3M/C(-L)-HS-6P

Specifications	MER2-041-608U3C-HS-6P MER2-041-608U3C-L-HS-6P	MER2-041-608U3M-HS-6P MER2-041-608U3M-L-HS-6P
Resolution	720 × 540	
Sensor	Sony IMX287 global shutter CMOS	
Max. Image Circle	1/2.9 inch	
Pixel Size	6.9μm × 6.9μm	
Frame Rate	608fps@720 × 540	
ADC Bit Depth	8bit, 10bit, 12bit	
Pixel Bit Depth	8bit, 10bit, 12bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer RG8/Bayer RG10/Bayer RG12	Mono8/Mono10/Mono12
Signal Noise Ratio	43.3dB	43.3dB
Exposure Time	UltraShort: 1μs~100μs, Actual Steps: 1μs Standard: 20μs~1s, Actual Steps: 1 row period	
Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB	
Binning	1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4	
Decimation	FPGA: 1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4	
Synchronization	Hardware trigger (MER2-U3-L: N/A), software trigger	
I/O	1 input and 1 output with opto-isolated, 1 programmable GPIO (MER2-U3-L: N/A)	
Operating Temp.	0°C~45°C	
Storage Temp.	-20°C~70°C	
Operating Humidity	10%~80%	
Typical Power	1.99W@5V	
Power Requirements	Power over USB3.0	
Lens Mount	C	
Data Interface	USB3.0	
Dimensions	29mm×29mm×29mm (without lens adapter or connectors)	
Weight	MER2-U3: 65g, MER2-U3-L: 61g	

Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8
Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity (MER2-U3-L not support trigger polarity and flash polarity)
Conformity	CE, RoHS, FCC, ICES, UKCA, UL, USB3 Vision, GenICam

Table 4-30 MER2-041-608U3M/C(-L)-HS-6P camera specifications

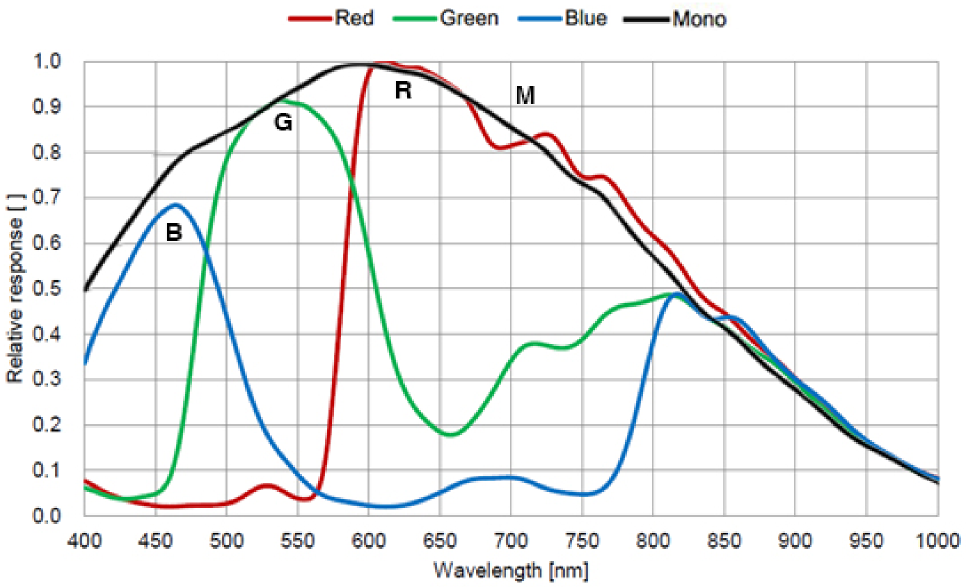


Figure 4-30 MER2-041-608U3M/C(-L)-HS-6P sensor spectral response

4.3.2. MER2-160-249U3M/C(-L)-HS-6P

Specifications	MER2-160-249U3C-HS-6P MER2-160-249U3C-L-HS-6P	MER2-160-249U3M-HS-6P MER2-160-249U3M-L-HS-6P
Resolution	1440 × 1080	
Sensor	Sony IMX273 global shutter CMOS	
Max. Image Circle	1/2.9 inch	
Pixel Size	3.45μm × 3.45μm	
Frame Rate	249.2fps@1440 × 1080	
ADC Bit Depth	8bit, 10bit, 12bit	
Pixel Bit Depth	8bit, 10bit, 12bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer RG8/Bayer RG10/Bayer RG12	Mono8/Mono10/Mono12
Signal Noise Ratio	40.5dB	40.5dB
Exposure Time	UltraShort: 1μs~100μs, Actual Steps: 1μs Standard: 20μs~1s, Actual Steps: 1 row period	

Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB
Binning	1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4
Decimation	Sensor: 1×1, 2×2
Synchronization	Hardware trigger (MER2-U3-L: N/A), software trigger
I/O	1 input and 1 output with opto-isolated, 1 programmable GPIO (MER2-U3-L: N/A)
Operating Temp.	0°C~45°C
Storage Temp.	-20°C~70°C
Operating Humidity	10%~80%
Typical Power	2.33W@5V
Power Requirements	Power over USB3.0
Lens Mount	C
Data Interface	USB3.0
Dimensions	29mm×29mm×29mm (without lens adapter or connectors)
Weight	MER2-U3: 65g, MER2-U3-L: 61g
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8
Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity (MER2-U3-L not support trigger polarity and flash polarity)
Conformity	CE, RoHS, FCC, ICES, UKCA, UL, USB3 Vision, GenICam

Table 4-31 MER2-160-249U3M/C(-L)-HS-6P camera specifications

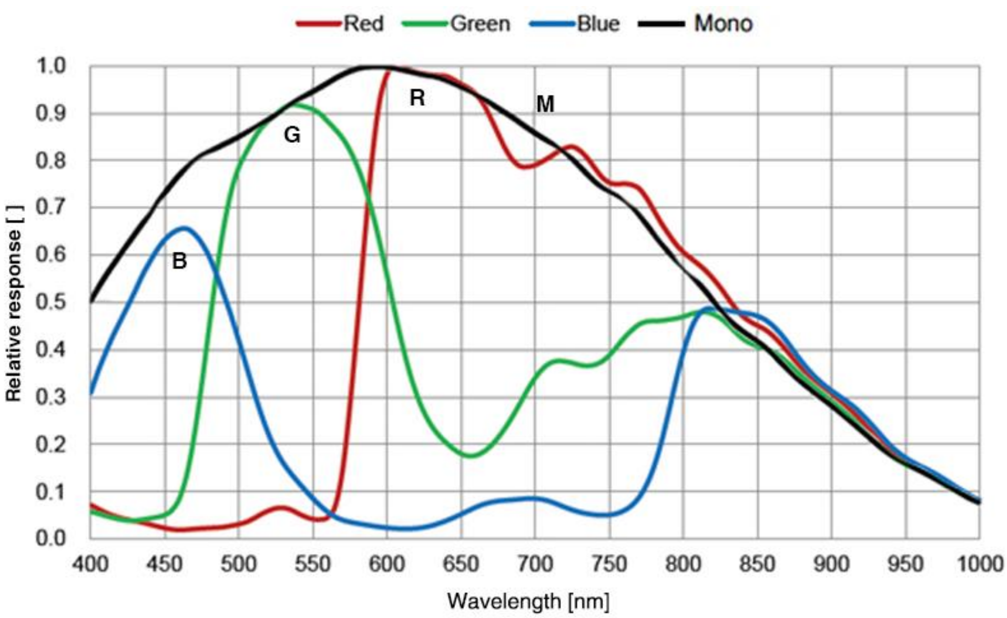


Figure 4-31 MER2-160-249U3M/C(-L)-HS-6P sensor spectral response

4.4. ME2S-U3 Series

4.4.1. ME2S-560-70U3M/C

Specifications	ME2S-560-70U3C	ME2S-560-70U3M
Resolution	2600 × 2160	
Sensor	Gpixel GMAX2505 global shutter CMOS	
Max. Image Circle	1/2 inch	
Pixel Size	2.5μm × 2.5μm	
Frame Rate	70.3fps @ 2600 × 2160	
ADC Bit Depth	12bit	
Pixel Bit Depth	8bit, 12bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer GB8/Bayer GB12	Mono8/Mono12
Signal Noise Ratio	37.34dB	37.21dB
Exposure Time	Standard: 11μs~1s, Actual Steps: 1μs	
Gain	0dB~16dB, Default: 0dB, Steps: 0.1dB	
Binning	1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4	
Decimation	Horizontal FPGA, Vertical Sensor: 1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4	
Synchronization	Hardware trigger, software trigger	
I/O	1 input and 1 output with opto-isolated, 1 programmable GPIO	
Operating Temp.	0°C~45°C	
Storage Temp.	-20°C~70°C	
Operating Humidity	10%~80%	
Typical Power	3.76W@5V	
Power Requirements	Power over USB3.0	
Lens Mount	C	
Data Interface	USB3.0	
Dimensions	29mm×29mm×38.8mm (without lens adapter or connectors)	
Weight	60g	

Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8
Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity
Conformity	CE, RoHS, FCC, ICES, UKCA, USB3 Vision, GenICam

Table 4-32 ME2S-560-70U3M/C camera specifications

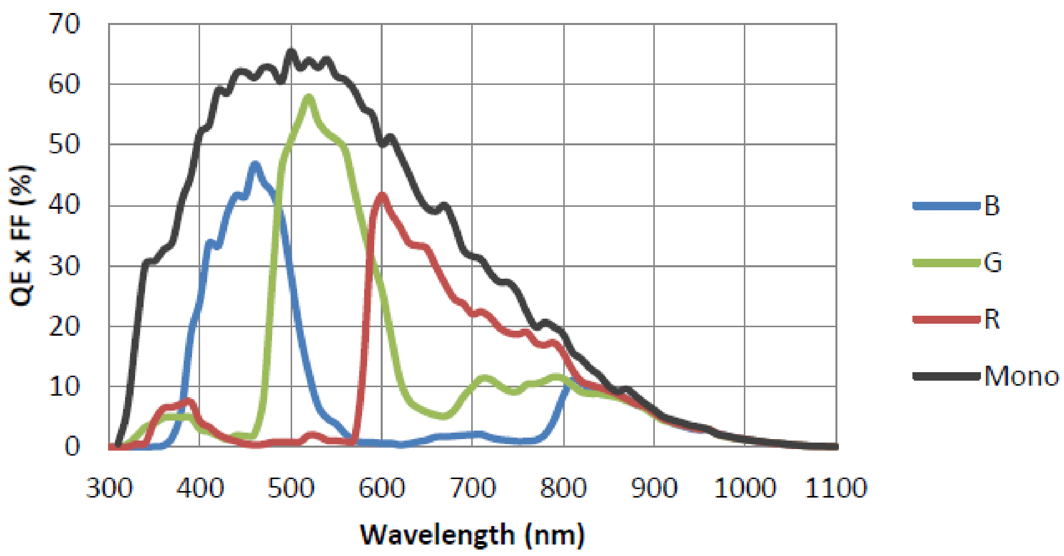


Figure 4-32 ME2S-560-70U3M/C sensor spectral response

4.4.2. ME2S-1260-28U3M/C

Specifications	ME2S-1260-28U3C	ME2S-1260-28U3M
Resolution	4096 × 3072	
Sensor	ON XGS12000 global shutter CMOS	
Max. Image Circle	1 inch	
Pixel Size	3.2μm × 3.2μm	
Frame Rate	28fps @ 4096 × 3072	
ADC Bit Depth	12bit	
Pixel Bit Depth	8bit, 12bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer RG8/Bayer RG12	Mono8/Mono12
Signal Noise Ratio	39.94dB	39.78dB
Exposure Time	UltraShort: 52μs~161μs, Actual Steps: 1μs Standard: 162μs~1s, Actual Steps: 1μs	
Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB	

Binning	1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4
Decimation	Sensor: 1×1, 1×2, 2×1, 2×2
Synchronization	Hardware trigger, software trigger
I/O	1 input and 1 output with opto-isolated, 1 programmable GPIO
Operating Temp.	0°C~45°C
Storage Temp.	-20°C~70°C
Operating Humidity	10%~80%
Typical Power	4.04W@5V
Power Requirements	Power over USB3.0
Lens Mount	C
Data Interface	USB3.0
Dimensions	29mm×29mm×38.8mm (without lens adapter or connectors)
Weight	60g
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8
Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity
Conformity	CE, RoHS, FCC, ICES, UKCA, USB3 Vision, GenICam

Table 4-33 ME2S-1260-28U3M/C camera specifications

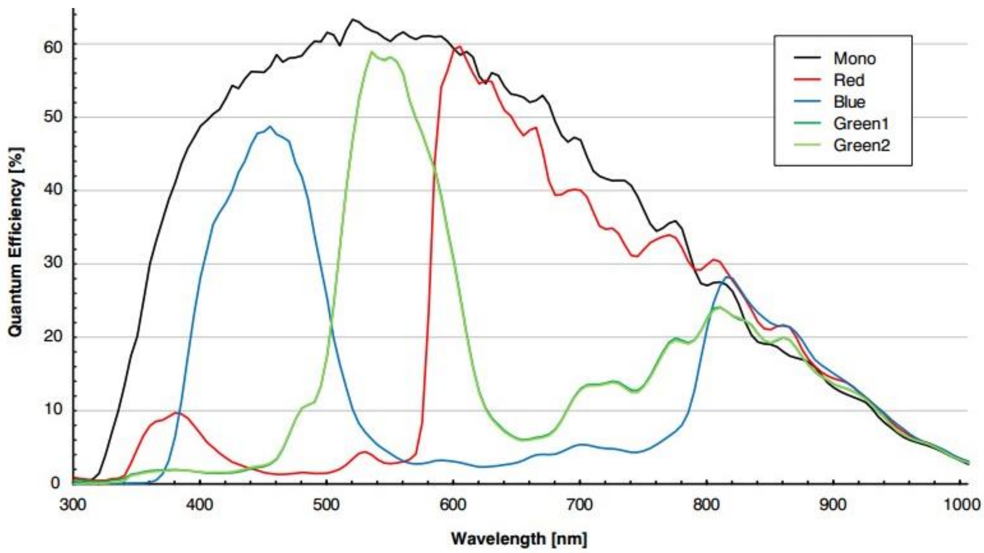


Figure 4-33 ME2S-1260-28U3M/C sensor spectral response

4.4.3. ME2S-1610-24U3M/C

Specifications	ME2S-1610-24U3C	ME2S-1610-24U3M
Resolution	5320 × 3032	
Sensor	Sony IMX542 global shutter CMOS	
Max. Image Circle	1.1 inch	
Pixel Size	2.74μm × 2.74μm	
Frame Rate	24.4fps @ 5320 × 3032	
ADC Bit Depth	12bit	
Pixel Bit Depth	8bit, 10bit, 12bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer RG8/Bayer RG10/Bayer RG12	Mono8/Mono10/Mono12
Signal Noise Ratio	40.7dB	42.1dB
Exposure Time	UltraShort: 1μs~2.4μs, Actual Steps: 1μs Standard: 3μs~1s, Actual Steps: 1 row period (decimation enabled/>20μs), 1μs (3μs~20μs)	
Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB	
Binning	1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4	
Decimation	Sensor: 1×1, 2×2	
Synchronization	Hardware trigger, software trigger	
I/O	1 input and 1 output with opto-isolated, 1 programmable GPIO	
Operating Temp.	0°C~45°C	
Storage Temp.	-20°C~70°C	
Operating Humidity	10%~80%	
Typical Power	4.03W@5V	
Power Requirements	12VDC-10% ~ 24VDC+10% supplied via Hirose connector (recommend) or power over USB3.0	
Lens Mount	C	
Data Interface	USB3.0	
Dimensions	29mm×29mm×38.8mm (without lens adapter or connectors)	
Weight	60g	
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8	

Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity
Conformity	CE, RoHS, FCC, ICES, UKCA, USB3 Vision, GenICam

Table 4-34 ME2S-1610-24U3M/C camera specifications

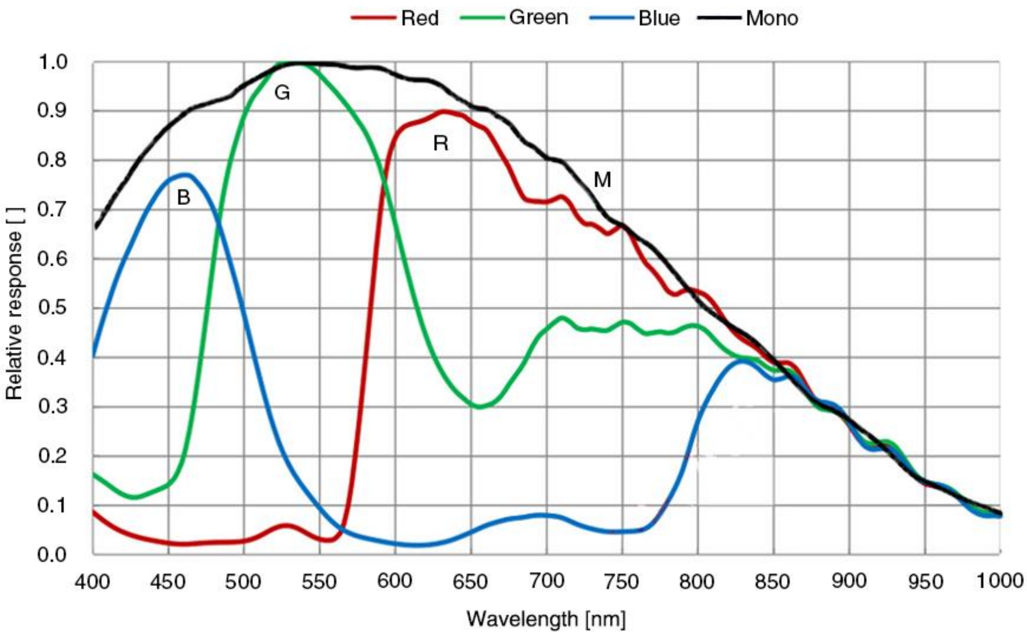


Figure 4-34 ME2S-1610-24U3M/C sensor spectral response

4.4.4. ME2S-2020-19U3M/C

Specifications	ME2S-2020-19U3C	ME2S-2020-19U3M
Resolution	4504 × 4504	
Sensor	Sony IMX541 global shutter CMOS	
Max. Image Circle	1.1 inch	
Pixel Size	2.74μm × 2.74μm	
Frame Rate	19.4fps @ 4504 × 4504	
ADC Bit Depth	12bit	
Pixel Bit Depth	8bit, 10bit, 12bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer RG8/Bayer RG10/Bayer RG12	Mono8/Mono10/Mono12
Signal Noise Ratio	40.6dB	42.1dB
Exposure Time	UltraShort: 1μs~2.4μs, Actual Steps: 1μs Standard: 3μs~1s, Actual Steps: 1 row period (decimation enabled/3μs~20μs), 1μs (>20μs)	

Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB
Binning	1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4
Decimation	Sensor: 1×1, 2×2
Synchronization	Hardware trigger, software trigger
I/O	1 input and 1 output with opto-isolated, 1 programmable GPIO
Operating Temp.	0°C~45°C
Storage Temp.	-20°C~70°C
Operating Humidity	10%~80%
Typical Power	3.93W@5V
Power Requirements	12VDC-10% ~ 24VDC+10% supplied via Hirose connector (recommend) or power over USB3.0
Lens Mount	C
Data Interface	USB3.0
Dimensions	29mm×29mm×38.8mm (without lens adapter or connectors)
Weight	60g
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8
Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity
Conformity	CE, RoHS, FCC, ICES, UKCA, USB3 Vision, GenICam

Table 4-35 ME2S-2020-19U3M/C camera specifications

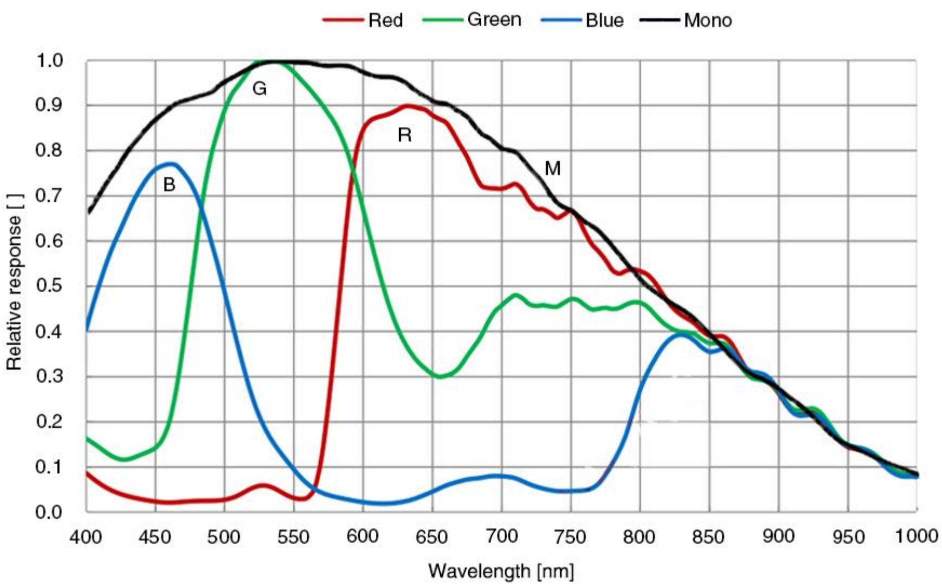


Figure 4-35 ME2S-2020-19U3M/C sensor spectral response

4.4.5. ME2S-2440-16U3M/C

Specifications	ME2S-2440-16U3C	ME2S-2440-16U3M
Resolution	5328 × 4608	
Sensor	Sony IMX540 global shutter CMOS	
Max. Image Circle	1.2 inch	
Pixel Size	2.74μm × 2.74μm	
Frame Rate	16.1fps @ 5328 × 4608	
ADC Bit Depth	12bit	
Pixel Bit Depth	8bit, 10bit, 12bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer RG8/Bayer RG10/Bayer RG12	Mono8/Mono10/Mono12
Signal Noise Ratio	41.2dB	42.3dB
Exposure Time	UltraShort: 1μs~2.4μs, Actual Steps: 1μs Standard: 3μs~1s, Actual Steps: 1 row period (decimation enabled/3μs~20μs), 1μs (>20μs)	
Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB	
Binning	1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4	
Decimation	Sensor: 1×1, 2×2	
Synchronization	Hardware trigger, software trigger	
I/O	1 input and 1 output with opto-isolated, 1 programmable GPIO	
Operating Temp.	0°C~45°C	
Storage Temp.	-20°C~70°C	
Operating Humidity	10%~80%	
Typical Power	4.00W@5V	
Power Requirements	12VDC-10% ~ 24VDC+10% supplied via Hirose connector (recommend) or power over USB3.0	
Lens Mount	C	
Data Interface	USB3.0	
Dimensions	29mm×29mm×38.8mm (without lens adapter or connectors)	
Weight	60g	

Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8
Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity
Conformity	CE, RoHS, FCC, ICES, UKCA, USB3 Vision, GenICam

Table 4-36 ME2S-2440-16U3M/C camera specifications

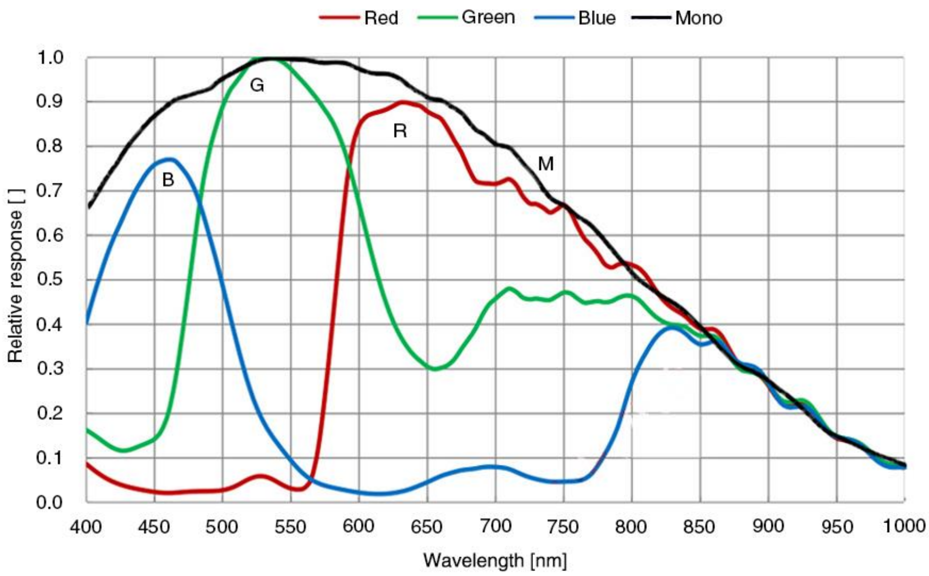


Figure 4-36 ME2S-2440-16U3M/C sensor spectral response

4.4.6. ME2S-2560-15U3M

Specifications	ME2S-2560-15U3M
Resolution	5064 × 5064
Sensor	global shutter CMOS
Max. Image Circle	1.1 inch
Pixel Size	2.5μm × 2.5μm
Frame Rate	15.4fps @ 5064 × 5064
ADC Bit Depth	12bit
Pixel Bit Depth	8bit, 10bit, 12bit
Mono/Color	Mono
Pixel Formats	Mono8/Mono10/Mono12
Signal Noise Ratio	41.03dB
Exposure Time	UltraShort: 1μs~2.4μs, Actual Steps: 1μs Standard: 3μs~1s, Actual Steps: 1 row period (decimation enabled/3μs~20μs), 1μs (>20μs)

Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB
Binning	1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4
Decimation	–
Synchronization	Hardware trigger, software trigger
I/O	1 input and 1 output with opto-isolated, 1 programmable GPIO
Operating Temp.	0°C~45°C
Storage Temp.	-20°C~70°C
Operating Humidity	10%~80%
Typical Power	3.90W@5V
Power Requirements	12VDC-10% ~ 24VDC+10% supplied via Hirose connector (recommend) or power over USB3.0
Lens Mount	C
Data Interface	USB3.0
Dimensions	29mm×29mm×38.8mm (without lens adapter or connectors)
Weight	60g
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8
Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity
Conformity	CE, RoHS, FCC, ICES, UKCA, USB3 Vision, GenICam

Table 4-37 ME2S-2560-15U3M camera specifications

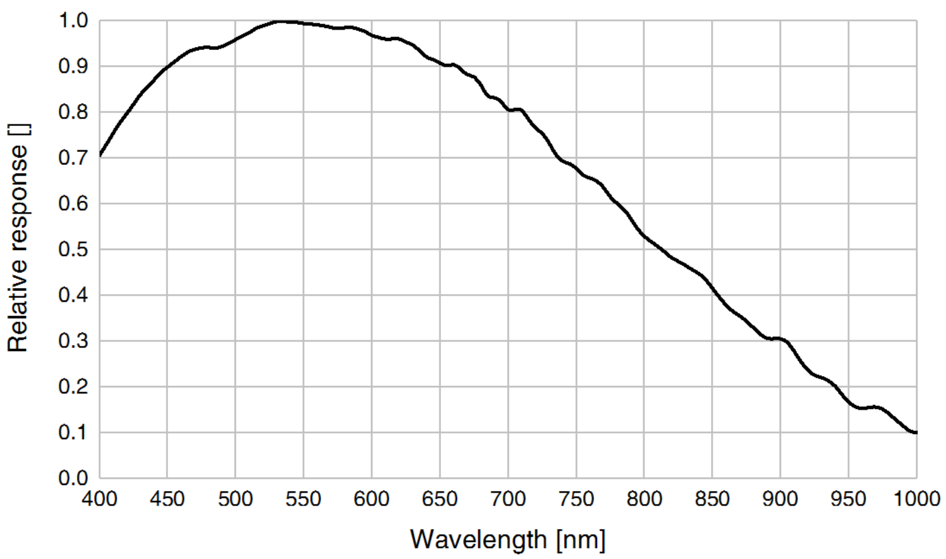


Figure 4-37 ME2S-2560-15U3M sensor spectral response

4.5. ME2S-U3-SWIR Series

Due to the inherent characteristics of the ME2S-U3-SWIR series camera sensor chip, defect pixels will gradually increase under conditions of long exposure (5ms and above) and higher sensor temperatures. While the camera features both dynamic defect pixel correction and static defect pixel correction, continuous defect pixels or an excessive number of defect pixels cannot be completely removed by these corrections. Therefore, the following usage recommendations are provided:

1) Ensure both Dynamic Defect Pixel Correction and Static Defect Pixel Correction are enabled.

2) Try to use shorter exposure settings combined with supplemental lighting.

3) Mount the camera on a metal bracket and use a suitable lens. If necessary, heat sinks can be optionally installed. The ME2S-U3-SWIR cameras come as standard with two heat sinks. Alternatively, implement other active cooling measures.

4.5.1. ME2S-138-136U3M-SWIR

Specifications	ME2S-138-136U3M-SWIR
Resolution	1280 × 1024
Sensor	Sony IMX990 global shutter CMOS
Max. Image Circle	1/2 inch
Pixel Size	5μm × 5μm
Frame Rate	136fps @ 1280 × 1024
ADC Bit Depth	8bit, 10bit, 12bit
Pixel Bit Depth	8bit, 10bit, 12bit
Mono/Color	Mono, SWIR
Pixel Formats	Mono8/Mono10/Mono12
Signal Noise Ratio	50.6dB
Exposure Time	UltraShort: 3μs~100μs, Actual Steps: 1μs Standard: 13μs~1s, Actual Steps: 1 row period
Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB
Binning	1×1, 1×2, 2×1, 2×2
Decimation	Sensor: 1×1, 2×2
Synchronization	Hardware trigger, software trigger

I/O	1 input and 1 output with opto-isolated, 1 programmable GPIO
Operating Temp.	0°C~45°C
Storage Temp.	-20°C~70°C
Operating Humidity	10%~80%
Typical Power	3.04W@5V
Power Requirements	12VDC-10% ~ 24VDC+10% supplied via Hirose connector or power over USB3.0
Lens Mount	C
Filters / Transparent Glass	-
Data Interface	USB3.0
Dimensions	29mm×29mm×38.8mm (without lens adapter, connectors or Heat Dissipation Fins) 85.2mm×29mm×38.8mm(without lens adapter or connectors, with Heat Dissipation Fins)
Weight	60g (without Heat Dissipation Fins)
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8
Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity
Conformity	CE, RoHS, FCC, ICES, UKCA, USB3 Vision, GenICam

Table 4-38 ME2S-138-136U3M-SWIR camera specifications

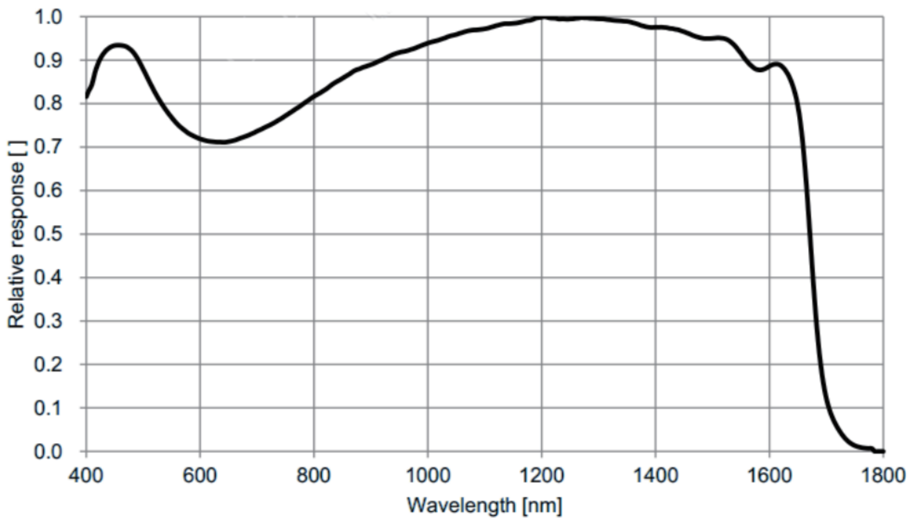


Figure 4-38 ME2S-138-136U3M-SWIR sensor spectral response

4.5.2. ME2S-138-232U3M-SWIR

Specifications	ME2S-138-232U3M-SWIR
Resolution	1280 × 1024
Sensor	Sony IMX990 global shutter CMOS
Max. Image Circle	1/2 inch
Pixel Size	5μm × 5μm
Frame Rate	232.9fps @ 1280 × 1024
ADC Bit Depth	8bit, 10bit, 12bit
Pixel Bit Depth	8bit, 10bit, 12bit
Mono/Color	Mono, SWIR
Pixel Formats	Mono8/Mono10/Mono12
Signal Noise Ratio	50.8dB
Exposure Time	UltraShort: 3μs~100μs, Actual Steps: 1μs Standard: 13μs~1s, Actual Steps: 1 row period
Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB
Binning	1×1, 1×2, 2×1, 2×2
Decimation	Sensor: 1×1, 2×2
Synchronization	Hardware trigger, software trigger
I/O	1 input and 1 output with opto-isolated, 1 programmable GPIO
Operating Temp.	0°C~45°C
Storage Temp.	-20°C~70°C
Operating Humidity	10%~80%
Typical Power	3.83W@5V
Power Requirements	12VDC-10% ~ 24VDC+10% supplied via Hirose connector or power over USB3.0
Lens Mount	C
Filters / Transparent Glass	-
Data Interface	USB3.0
Dimensions	29mm×29mm×38.8mm (without lens adapter, connectors or Heat Dissipation Fins) 85.2mm×29mm×38.8mm(without lens adapter or connectors, with Heat Dissipation Fins)

Weight	60g (without Heat Dissipation Fins)
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8
Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity
Conformity	CE, RoHS, FCC, ICES, UKCA, USB3 Vision, GenICam

Table 4-39 ME2S-138-232U3M-SWIR camera specifications

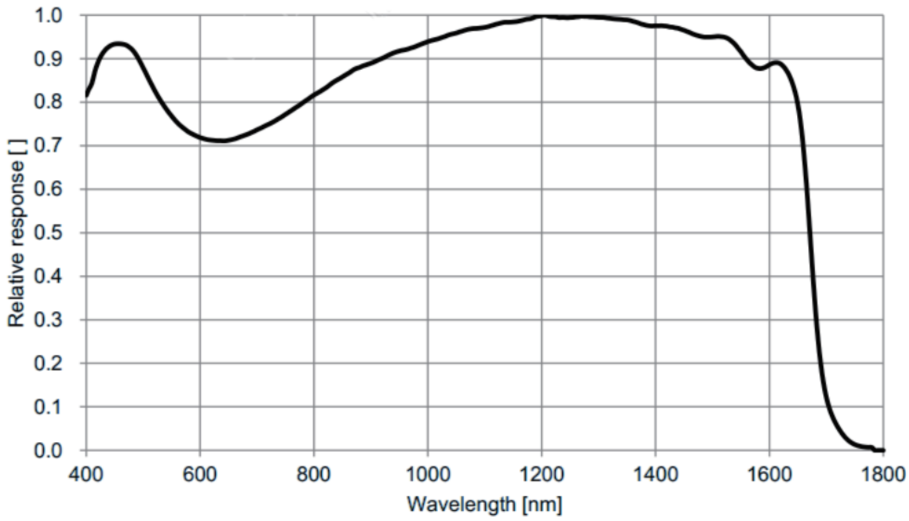


Figure 4-39 ME2S-138-232U3M-SWIR sensor spectral response

4.6. ME2P-U3 Series

4.6.1. ME2P-170-210U3M/C

Specifications	ME2P-170-210U3C	ME2P-170-210U3M
Resolution	1608 × 1104	
Sensor	Sony IMX425 global shutter CMOS	
Max. Image Circle	1.1 inch	
Pixel Size	9μm × 9μm	
Frame Rate	210.8fps@1608 × 1104	
ADC Bit Depth	10bit, 12bit	
Pixel Bit Depth	8bit, 10bit, 12bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer RG8/Bayer RG10/Bayer RG12	Mono8/Mono10/Mono12
Signal Noise Ratio	49.9dB	50dB

Exposure Time	UltraShort: 1μs~5μs, Actual Steps: 0.1μs Standard: 9μs~1s, Actual Steps: 1 row period
Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB
Binning	FPGA: 1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4
Decimation	FPGA: 1×1, 1×2, 2×1, 2×2
Synchronization	Hardware trigger, software trigger
I/O	1 input and 1 output with opto-isolated, 2 programmable GPIOs
Operating Temp.	0°C~45°C
Storage Temp.	-20°C~70°C
Operating Humidity	10%~80%
Typical Power	3.12W@5V
Power Requirements	12VDC-10% ~ 24VDC+10% supplied via Hirose connector or power over USB3.0
Lens Mount	C
Data Interface	USB3.0
Dimensions	36mm×31mm×38.8mm (without lens adapter or connectors)
Weight	66g
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8
Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity
Conformity	CE, RoHS, FCC, ICES, UKCA, USB3 Vision, GenICam

Table 4-40 ME2P-170-210U3M/C camera specifications

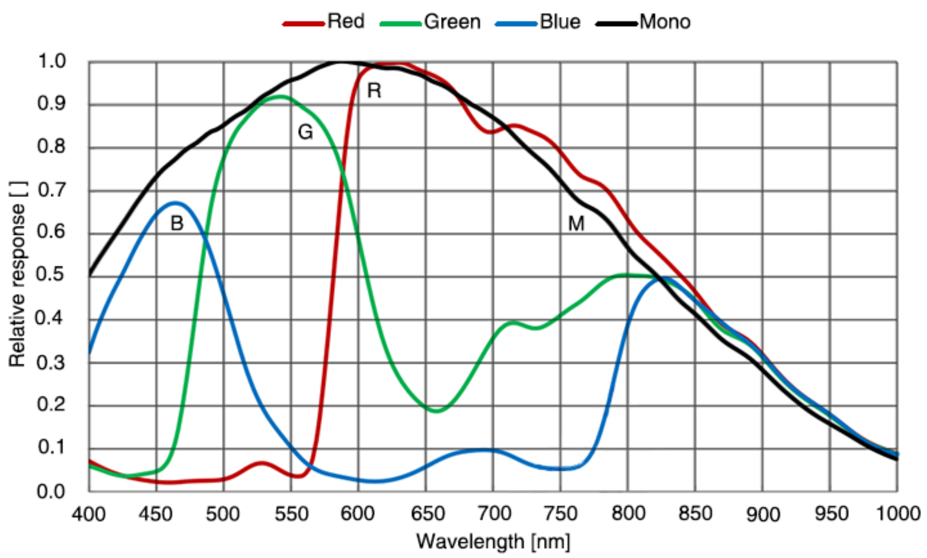


Figure 4-40 ME2P-170-210U3M/C sensor spectral response

4.6.2. ME2P-530-72U3M NIR \ ME2P-530-72U3C

Specifications	ME2P-530-72U3C	ME2P-530-72U3M NIR
Resolution	2592 × 2048	
Sensor	Onsemi PYTHON 5000 global shutter CMOS	
Max. Image Circle	1 inch	
Pixel Size	4.8μm × 4.8μm	
Frame Rate	72.4fps@2592 × 2048	
ADC Bit Depth	12bit	
Pixel Bit Depth	8bit, 10bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer GB8/Bayer GB10	Mono8/Mono10
Signal Noise Ratio	40.2dB	40.3dB
Exposure Time	Standard: 20μs~100ms, Actual Steps: 1 row period	
Gain	0dB~16dB, Default: 0dB, Steps: 0.1dB	
Binning	1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4	
Decimation	Sensor: 1×1, 1×2, 2×1, 2×2	
Synchronization	Hardware trigger, software trigger	
I/O	1 input and 1 output with opto-isolated, 2 programmable GPIOs	
Operating Temp.	0°C~45°C	
Storage Temp.	-20°C~70°C	
Operating Humidity	10%~80%	
Typical Power	3.25W@5V	
Power Requirements	Power over USB3.0	
Lens Mount	C	
Data Interface	USB3.0	
Dimensions	36mm×31mm×38.8mm (without lens adapter or connectors)	
Weight	66g	
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8	

Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity
Conformity	CE, RoHS, FCC, ICES, UKCA, USB3 Vision, GenICam

Table 4-41 ME2P-530-72U3M NIR \ ME2P-530-72U3C camera specifications

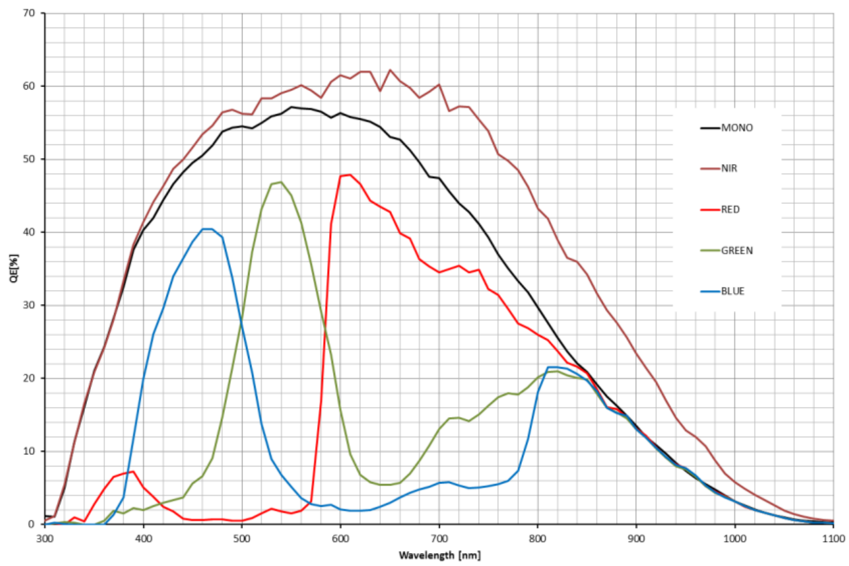


Figure 4-41 ME2P-530-72U3M NIR \ ME2P-530-72U3C sensor spectral response

4.6.3. ME2P-560-36U3M/C

Specifications	ME2P-560-36U3C	ME2P-560-36U3M
Resolution	2600 × 2160	
Sensor	Gpixel GMAX2505 global shutter CMOS	
Max. Image Circle	1/2 inch	
Pixel Size	2.5μm × 2.5μm	
Frame Rate	36.1fps@2600 × 2160	
ADC Bit Depth	12bit	
Pixel Bit Depth	8bit, 12bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer GB8/Bayer GB12	Mono8/Mono12
Signal Noise Ratio	37.36dB	37.19dB
Exposure Time	Standard: 11μs~1s, Actual Steps: 1μs	
Gain	0dB~16dB, Default: 0dB, Steps: 0.1dB	
Binning	1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4	

Decimation	Horizontal FPGA, Vertical Sensor: 1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4
Synchronization	Hardware trigger, software trigger
I/O	1 input and 1 output with opto-isolated, 2 programmable GPIOs
Operating Temp.	0°C~45°C
Storage Temp.	-20°C~70°C
Operating Humidity	10%~80%
Typical Power	2.18W@5V
Power Requirements	Power over USB3.0
Lens Mount	C
Data Interface	USB3.0
Dimensions	36mm×31mm×38.8mm (without lens adapter or connectors)
Weight	66g
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8
Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity
Conformity	CE, RoHS, FCC, ICES, UKCA, USB3 Vision, GenICam

Table 4-42 ME2P-560-36U3M/C camera specifications

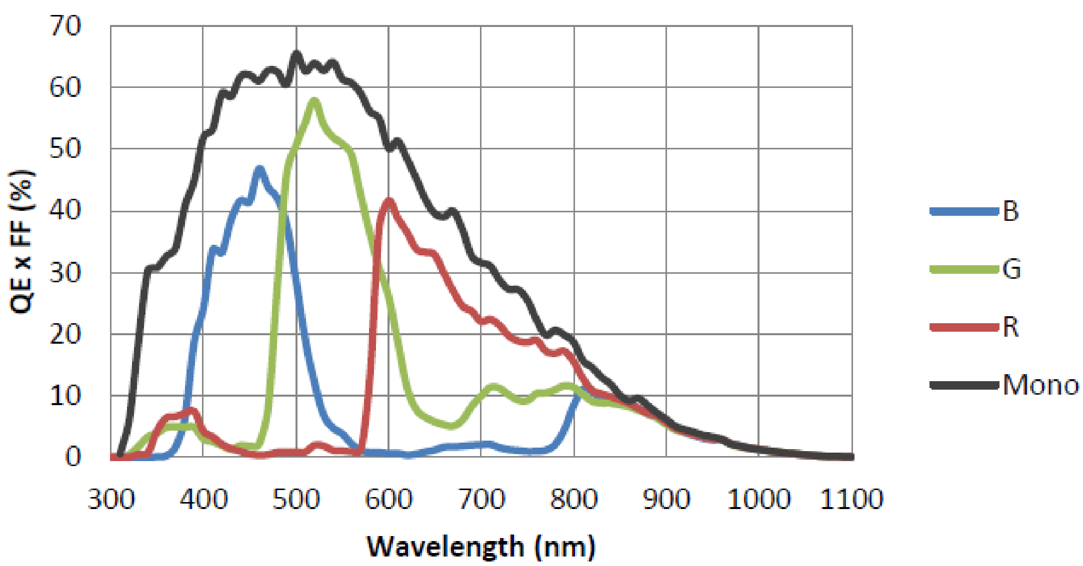


Figure 4-42 ME2P-560-36U3M/C sensor spectral response

4.6.4. ME2P-883-42U3M/C

Specifications	ME2P-883-42U3C	ME2P-883-42U3M
Resolution	4096 × 2160	
Sensor	Sony global shutter CMOS	
Max. Image Circle	1 inch	
Pixel Size	3.45μm × 3.45μm	
Frame Rate	42fps@4096 × 2160	
ADC Bit Depth	12bit	
Pixel Bit Depth	8bit, 12bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer RG8/Bayer RG12	Mono8/Mono12
Signal Noise Ratio	40.27dB	40.38dB
Exposure Time	UltraShort: 1μs~100μs, Actual Steps: 1μs Standard: 28μs~1s, Actual Steps: 1 row period	
Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB	
Binning	1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4	
Decimation	-	
Synchronization	Hardware trigger, software trigger	
I/O	1 input and 1 output with opto-isolated, 2 programmable GPIOs	
Operating Temp.	0°C~45°C	
Storage Temp.	-20°C~70°C	
Operating Humidity	10%~80%	
Typical Power	3.05W@5V	
Power Requirements	Power over USB3.0	
Lens Mount	C	
Data Interface	USB3.0	
Dimensions	36mm×31mm×38.8mm (without lens adapter or connectors)	
Weight	66g	

Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8
Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity
Conformity	CE, RoHS, FCC, ICES, UKCA, USB3 Vision, GenICam

Table 4-43 ME2P-883-42U3M/C camera specifications

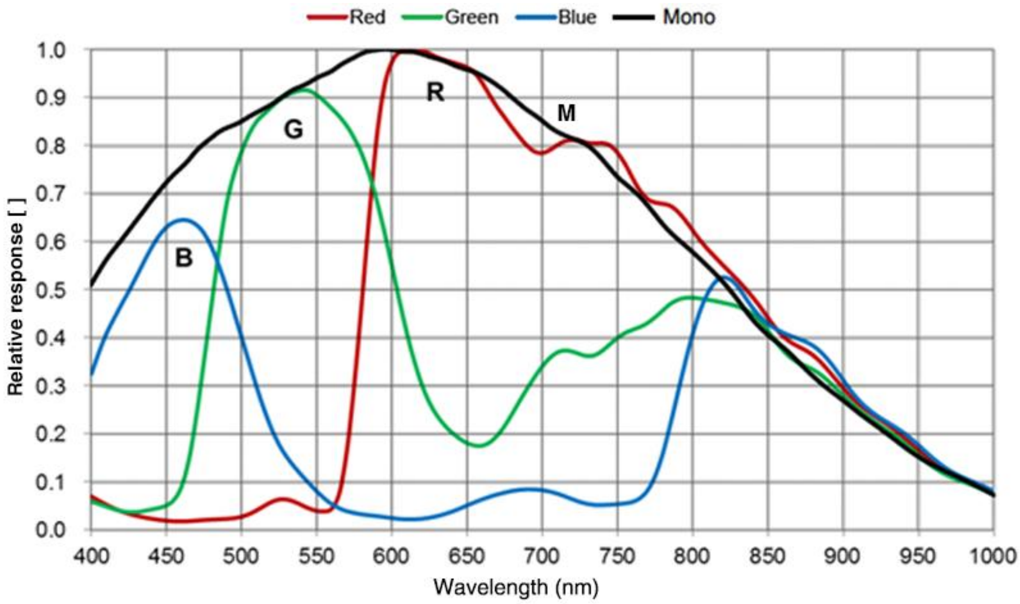


Figure 4-43 ME2P-883-42U3M/C sensor spectral response

4.6.5. ME2P-900-43U3M/C

Specifications	ME2P-900-43U3C	ME2P-900-43U3M
Resolution	4200 × 2160	
Sensor	Gpixel GMAX2509 global shutter CMOS	
Max. Image Circle	2/3 inch	
Pixel Size	2.5μm × 2.5μm	
Frame Rate	43.5fps@4200 × 2160	
ADC Bit Depth	12bit	
Pixel Bit Depth	8bit, 12bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer GB8/Bayer GB12	Mono8/Mono12
Signal Noise Ratio	37.15dB	36.94dB
Exposure Time	Standard: 11μs~1s, Actual Steps: 1μs	

Gain	0dB~16dB, Default: 0dB, Steps: 0.1dB
Binning	1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4
Decimation	Horizontal FPGA, Vertical Sensor: 1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4
Synchronization	Hardware trigger, software trigger
I/O	1 input and 1 output with opto-isolated, 2 programmable GPIOs
Operating Temp.	0°C~45°C
Storage Temp.	-20°C~70°C
Operating Humidity	10%~80%
Typical Power	2.83W@5V
Power Requirements	Power over USB3.0
Lens Mount	C
Data Interface	USB3.0
Dimensions	36mm×31mm×38.8mm (without lens adapter or connectors)
Weight	66g
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8
Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity
Conformity	CE, RoHS, FCC, ICES, UKCA, USB3 Vision, GenICam

Table 4-44 ME2P-900-43U3M/C camera specifications

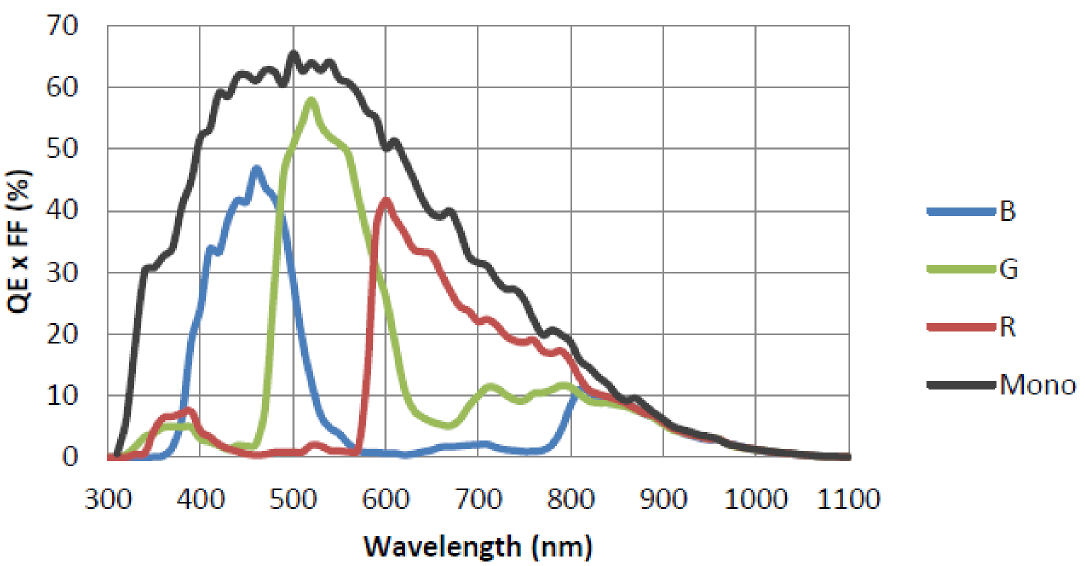


Figure 4-44 ME2P-900-43U3M/C sensor spectral response

4.6.6. ME2P-1230-23U3M/C

Specifications	ME2P-1230-23U3C	ME2P-1230-23U3M
Resolution	4096 × 3000	
Sensor	Sony IMX304 global shutter CMOS	
Max. Image Circle	1.1 inch	
Pixel Size	3.45μm × 3.45μm	
Frame Rate	23.5fps@4096 × 3000	
ADC Bit Depth	12bit	
Pixel Bit Depth	8bit, 12bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer RG8/Bayer RG12	Mono8/Mono12
Signal Noise Ratio	40.59dB	40.47dB
Exposure Time	UltraShort: 1μs~100μs, Actual Steps: 1μs Standard: 28μs~1s, Actual Steps: 1 row period	
Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB	
Binning	FPGA: 1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4 Sensor: 1×1, 1×2 (ME2P-U3M only)	
Decimation	Sensor: 1×1, 2×2	
Synchronization	Hardware trigger, software trigger	
I/O	1 input and 1 output with opto-isolated, 2 programmable GPIOs	
Operating Temp.	0°C~45°C	
Storage Temp.	-20°C~70°C	
Operating Humidity	10%~80%	
Typical Power	2.47W@5V	
Power Requirements	Power over USB3.0	
Lens Mount	C	
Data Interface	USB3.0	
Dimensions	36mm×31mm×38.8mm (without lens adapter or connectors)	
Weight	66g	

Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8
Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity
Conformity	CE, RoHS, FCC, ICES, UKCA, USB3 Vision, GenICam

Table 4-45 ME2P-1230-23U3M/C camera specifications

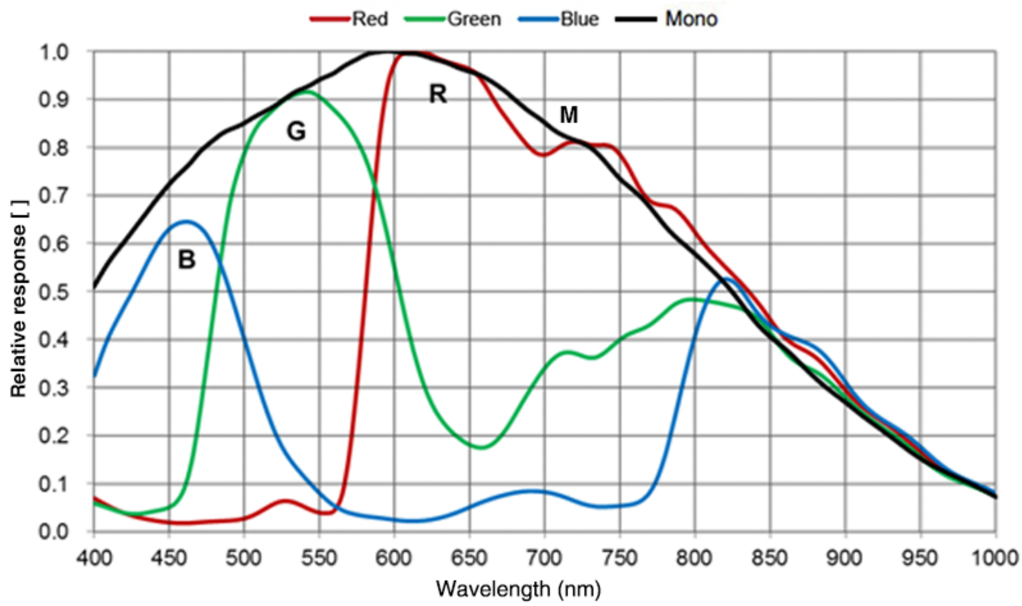


Figure 4-45 ME2P-1230-23U3M/C sensor spectral response

4.6.7. ME2P-1231-32U3M/C

Specifications	ME2P-1231-32U3C	ME2P-1231-32U3M
Resolution	4096 × 3000	
Sensor	Sony IMX253 global shutter CMOS	
Max. Image Circle	1.1 inch	
Pixel Size	3.45μm × 3.45μm	
Frame Rate	32.1fps@4096 × 3000	
ADC Bit Depth	8bit, 10bit, 12bit	
Pixel Bit Depth	8bit, 10bit, 12bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer RG8/Bayer RG10/Bayer RG12	Mono8/Mono10/Mono12
Signal Noise Ratio	40.79dB	40.63dB
Exposure Time	UltraShort: 1μs~100μs, Actual Steps: 1μs Standard: 24μs~1s, Actual Steps: 1 row period	

Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB
Binning	FPGA: 1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4 Sensor: 1×1, 1×2 (ME2P-U3M only)
Decimation	Sensor: 1×1, 2×2
Synchronization	Hardware trigger, software trigger
I/O	1 input and 1 output with opto-isolated, 2 programmable GPIOs
Operating Temp.	0°C~45°C
Storage Temp.	-20°C~70°C
Operating Humidity	10%~80%
Typical Power	3.05W@5V
Power Requirements	Power over USB3.0
Lens Mount	C
Data Interface	USB3.0
Dimensions	36mm×31mm×38.8mm (without lens adapter or connectors)
Weight	66g
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8
Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity
Conformity	CE, RoHS, FCC, ICES, UKCA, USB3 Vision, GenICam

Table 4-46 ME2P-1231-32U3M/C camera specifications

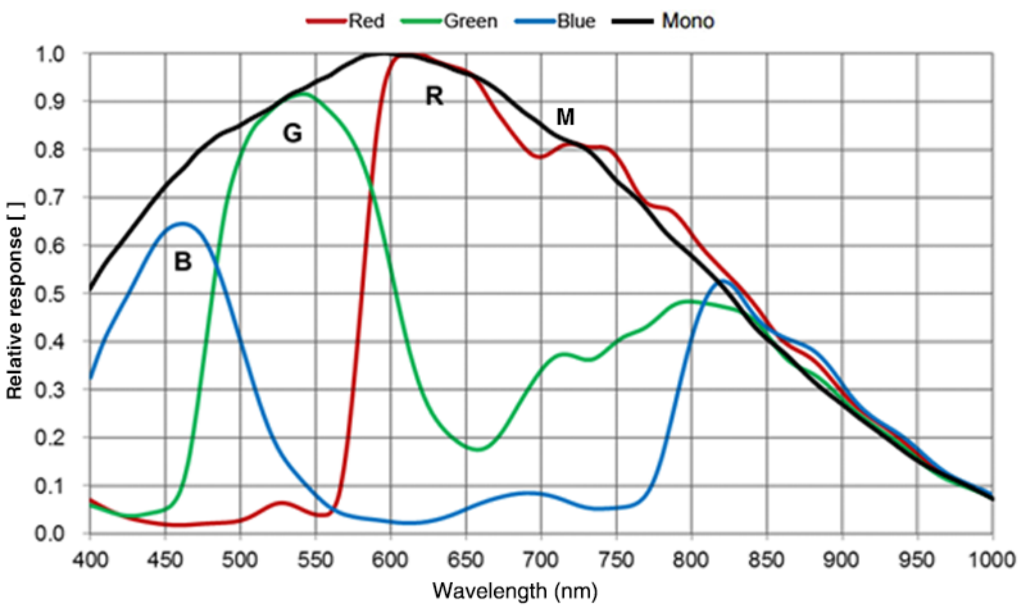


Figure 4-46 ME2P-1231-32U3M/C sensor spectral response

4.6.8. ME2P-1231-32U3M POL

Specifications	ME2P-1231-32U3M POL
Resolution	4096 × 3000
Sensor	Sony IMX253MZR global shutter CMOS
Max. Image Circle	1.1 inch
Pixel Size	3.45μm × 3.45μm
Frame Rate	32.1fps@4096 × 3000
ADC Bit Depth	8bit, 10bit, 12bit
Pixel Bit Depth	8bit, 10bit, 12bit
Mono/Color	Mono polarization
Pixel Formats	Mono8/Mono10/Mono12
Signal Noise Ratio	40.76dB
Exposure Time	UltraShort: 1μs~100μs, Actual Steps: 1μs Standard: 24μs~1s, Actual Steps: 1 row period
Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB
Binning	FPGA: 1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4 Sensor: 1×1, 1×2 (ME2P-U3M only)
Decimation	Sensor: 1×1, 2×2
Synchronization	Hardware trigger, software trigger
I/O	1 input and 1 output with opto-isolated, 2 programmable GPIOs
Operating Temp.	0°C~45°C
Storage Temp.	-20°C~70°C
Operating Humidity	10%~80%
Typical Power	3.05W@5V
Power Requirements	Power over USB3.0
Lens Mount	C
Data Interface	USB3.0
Dimensions	36mm×31mm×38.8mm (without lens adapter or connectors)
Weight	66g
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8

Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity
Conformity	CE, RoHS, FCC, ICES, UKCA, USB3 Vision, GenICam

Table 4-47 ME2P-1231-32U3M POL camera specifications

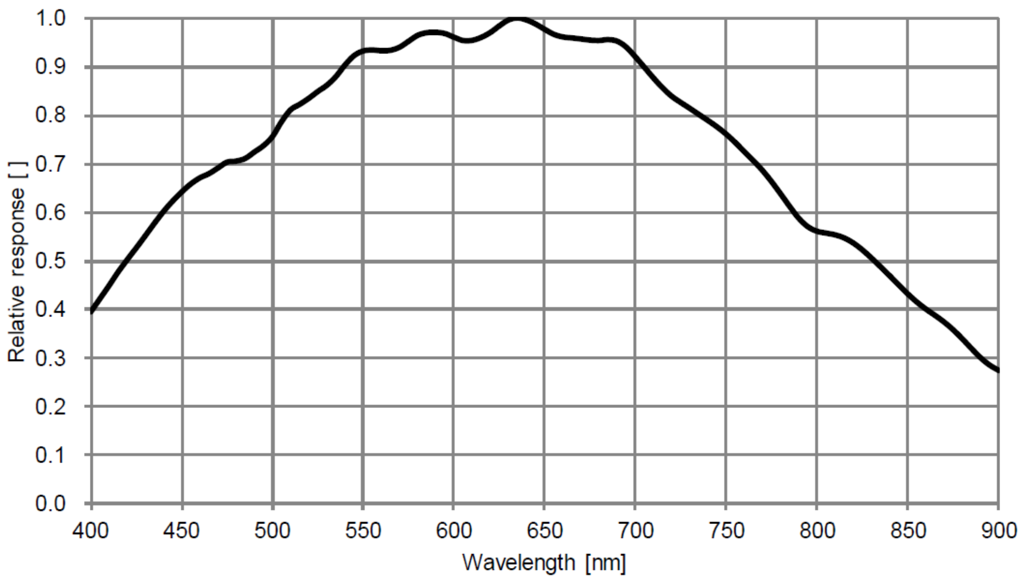


Figure 4-47 ME2P-1231-32U3M POL sensor spectral response

4.6.9. ME2P-1840-21U3M/C

Specifications	ME2P-1840-21U3C	ME2P-1840-21U3M
Resolution	4504 × 4096	
Sensor	Gpixel GMAX2518 global shutter CMOS	
Max. Image Circle	1 inch	
Pixel Size	2.5μm × 2.5μm	
Frame Rate	21.4fps@4504 × 4096	
ADC Bit Depth	12bit	
Pixel Bit Depth	8bit, 12bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer GB8/Bayer GB12	Mono8/Mono12
Signal Noise Ratio	38.5dB	38.28dB
Exposure Time	Standard: 11μs~1s, Actual Steps: 1μs	
Gain	0dB~16dB, Default: 0dB, Steps: 0.1dB	

Binning	1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4
Decimation	Horizontal FPGA, Vertical Sensor: 1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4
Synchronization	Hardware trigger, software trigger
I/O	1 input and 1 output with opto-isolated, 2 programmable GPIOs
Operating Temp.	0°C~45°C
Storage Temp.	-20°C~70°C
Operating Humidity	10%~80%
Typical Power	3.04W@5V
Power Requirements	Power over USB3.0
Lens Mount	C
Data Interface	USB3.0
Dimensions	36mm×31mm×38.8mm (without lens adapter or connectors)
Weight	66g
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8
Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity
Conformity	CE, RoHS, FCC, ICES, UKCA, USB3 Vision, GenICam

Table 4-48 ME2P-1840-21U3M/C camera specifications

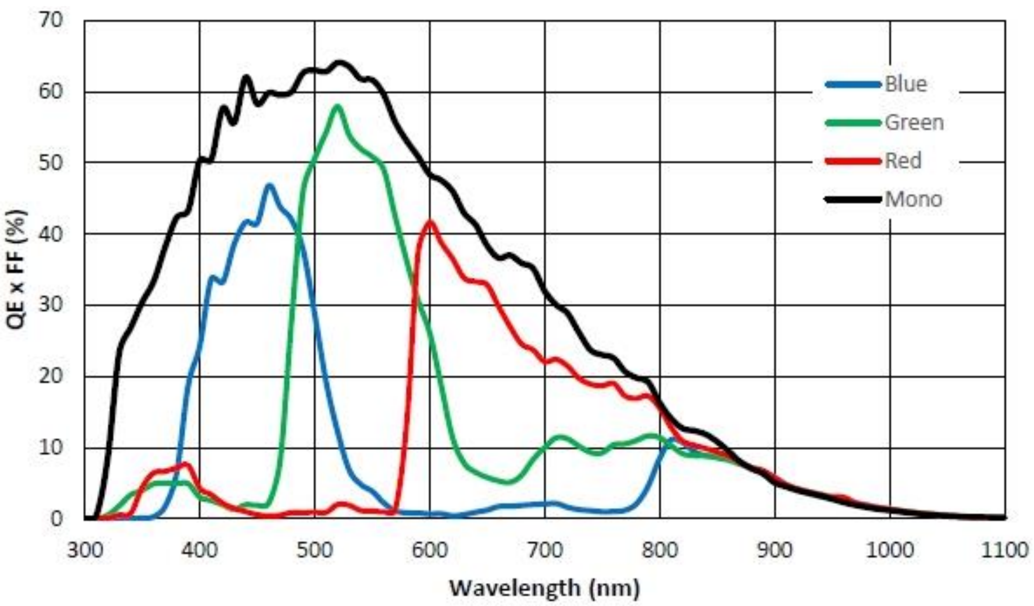


Figure 4-48 ME2P-1840-21U3M/C sensor spectral response

4.6.10. ME2P-2621-15U3M/C \ ME2P-2622-15U3M/C

Specifications	ME2P-2621-15U3C ME2P-2622-15U3C	ME2P-2621-15U3M ME2P-2622-15U3M
Resolution	5120 × 5120	
Sensor	GMAX0505 global shutter CMOS	
Max. Image Circle	1.1 inch	
Pixel Size	2.5μm × 2.5μm	
Frame Rate	15.1fps@5120 × 5120	
ADC Bit Depth	12bit	
Pixel Bit Depth	8bit, 12bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer GB8/Bayer GB12	Mono8/Mono12
Signal Noise Ratio	36.18dB	36.15dB
Exposure Time	Standard: 11μs~1s, Actual Steps: 1μs	
Gain	0dB~16dB, Default: 0dB, Steps: 0.1dB	
Binning	1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4	
Decimation	Horizontal FPGA, Vertical Sensor: 1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4	
Synchronization	Hardware trigger, software trigger	
I/O	1 input and 1 output with opto-isolated, 2 programmable GPIOs	
Operating Temp.	0°C~45°C	
Storage Temp.	-20°C~70°C	
Operating Humidity	10%~80%	
Typical Power	3.74W@5V	
Power Requirements	Power over USB3.0	
Lens Mount	C	
Data Interface	USB3.0	
Dimensions	36mm×31mm×38.8mm (without lens adapter or connectors)	
Weight	66g	
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8	
Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity	
Conformity	CE, RoHS, FCC, ICES, UKCA, USB3 Vision, GenICam	

Table 4-49 ME2P-2621-15U3M/C \ ME2P-2622-15U3M/C camera specifications

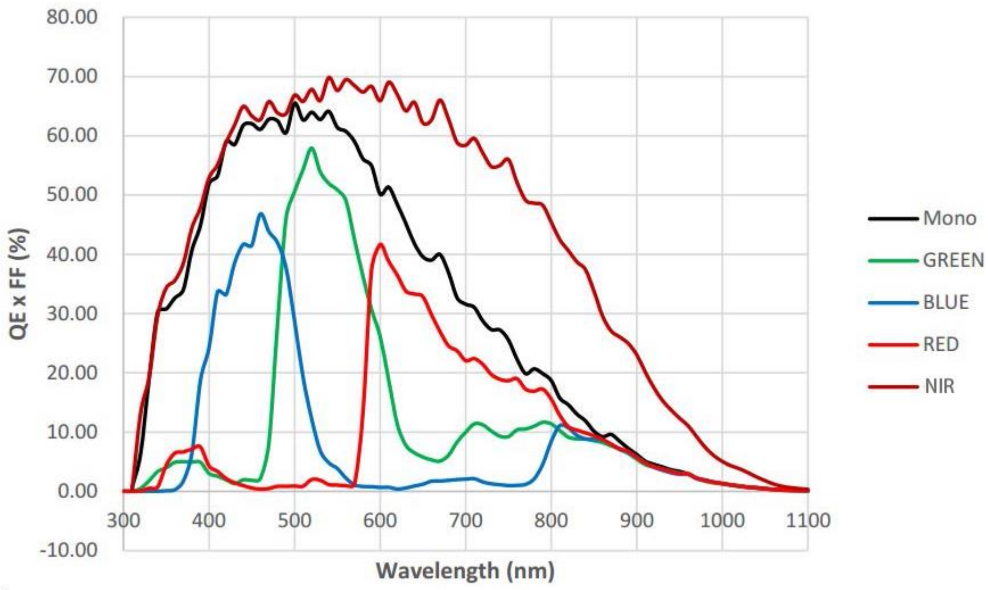


Figure 4-49 ME2P-2621-15U3M/C \ ME2P-2622-15U3M/C sensor spectral response

Note: ME2P-2622-15U3M/C is the Grade2 sensor, and ME2P-2621-15U3M/C is the Grade1 sensor. The only difference between the two cameras is the grade of the sensor. The difference between Grade1 and Grade2 sensors defined by sensor manufacturers is: Grade1 have no consecutive defect pixel cluster, and Grade2 may have up to 12 consecutive defect pixel cluster. The camera has static defect pixel correction function, and it will calibrated for the default factory parameters. If the scene parameters are changed, you can use the static defect pixel correction plugin to re-calibrate. For details please see section 9.3.

1) Monochrome camera

As shown below, cluster with 4 consecutive defect pixels in a row is not allowed (NOK).

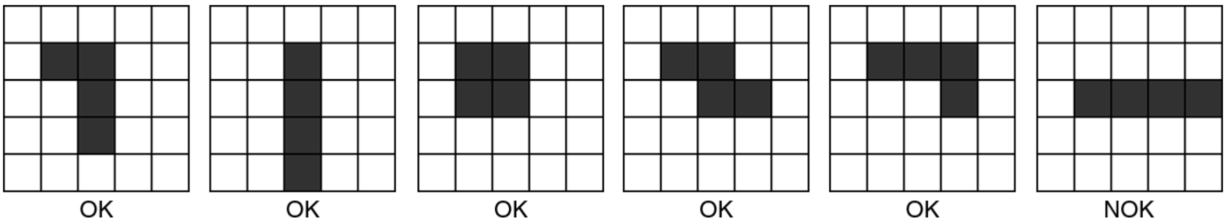


Figure 4-50 ME2P-2622-15U3M clusters distribution diagram

2) Color camera

Examples 1: Cluster with 4 consecutive defect pixels within the same Bayer color plane in a row is not allowed.

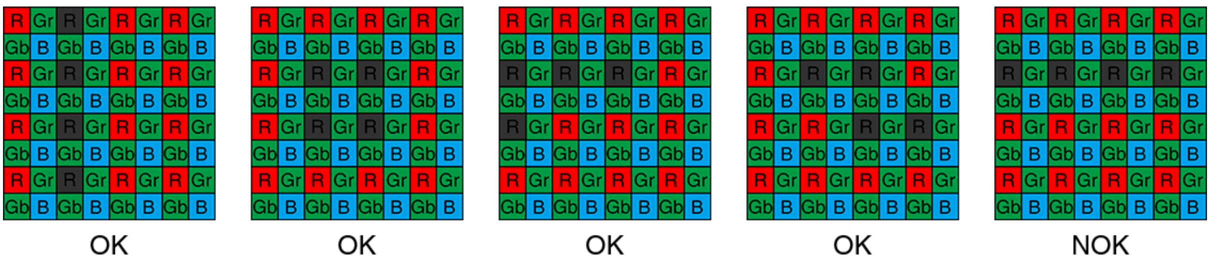


Figure 4-51 ME2P-2622-15U3C clusters within same Bayer color plane distribution diagram

Examples 2: When different Bayer color plane combined, maximum cluster size is 8 in any given 5x5 pixel array.

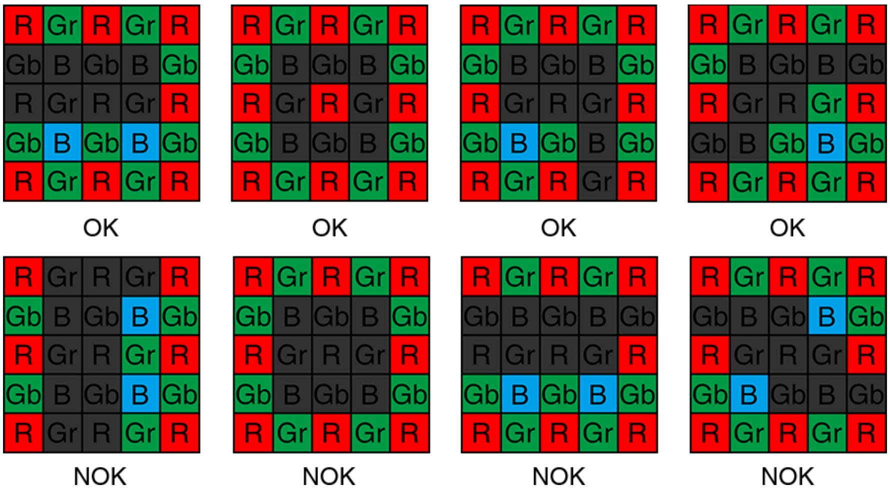


Figure 4-52 ME2P-2622-15U3C clusters within different Bayer color plane distribution diagram

*OK is allowed, NOK is not allowed.

4.6.11. ME2P-2621-15U3M NIR \ ME2P-2622-15U3M NIR

Specifications	ME2P-2621-15U3M NIR	ME2P-2622-15U3M NIR
Resolution	5120 × 5120	
Sensor	GMAX0505 global shutter CMOS	
Max. Image Circle	1.1 inch	
Pixel Size	2.5μm × 2.5μm	
Frame Rate	15.1ps@5120 × 5120	
ADC Bit Depth	12bit	
Pixel Bit Depth	8bit, 12bit	
Mono/Color	Mono, NIR	
Pixel Formats	Mono8/Mono12	
Signal Noise Ratio	36.15dB	
Exposure Time	Standard: 11μs~1s, Actual Steps: 1μs	
Gain	0dB~16dB, Default: 0dB, Steps: 0.1dB	
Binning	1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4	
Decimation	Horizontal FPGA, Vertical Sensor: 1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4	
Synchronization	Hardware trigger, software trigger	

I/O	1 input and 1 output with opto-isolated, 2 programmable GPIOs
Operating Temp.	0°C~45°C
Storage Temp.	-20°C~70°C
Operating Humidity	10%~80%
Typical Power	3.74W@5V
Power Requirements	Power over USB3.0
Lens Mount	C
Data Interface	USB3.0
Dimensions	36mm×31mm×38.8mm (without lens adapter or connectors)
Weight	66g
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8
Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity
Conformity	CE, RoHS, FCC, ICES, UKCA, USB3 Vision, GenICam

Table 4-50 ME2P-2621-15U3M NIR \ ME2P-2622-15U3M NIR camera specifications

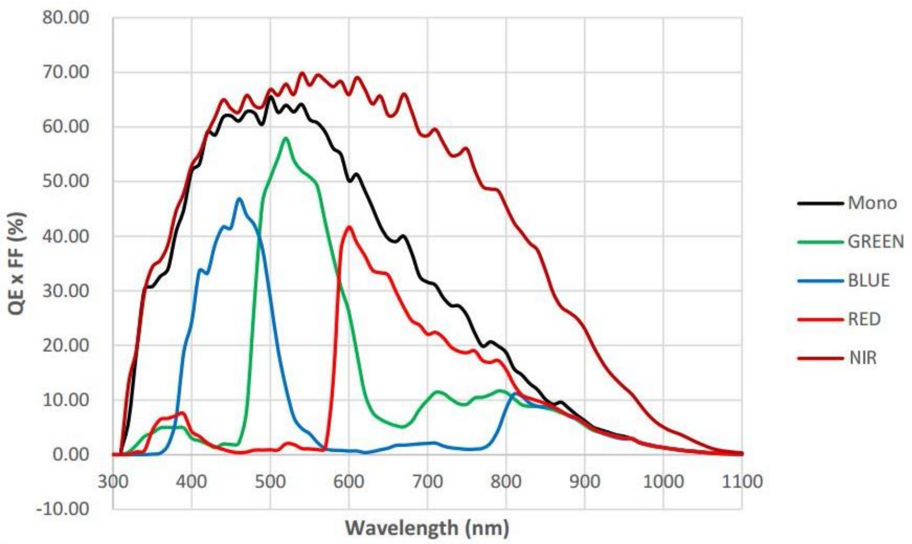


Figure 4-53 ME2P-2621-15U3M NIR \ ME2P-2622-15U3M NIR sensor spectral response

Note: ME2P-2622-15U3M NIR is the Grade2 sensor, and ME2P-2621-15U3M NIR is the Grade1 sensor. ME2P-2622-15U3M NIR clusters distribution diagram is same as ME2P-2622-15U3M clusters distribution diagram, see details in 4.6.10.

4.6.12. ME2P-1230-30U3M/C-HS

Specifications	ME2P-1230-30U3C-HS	ME2P-1230-30U3M-HS
Resolution	4096 × 3000	
Sensor	Sony IMX304 global shutter CMOS	
Max. Image Circle	1.1 inch	
Pixel Size	3.45μm × 3.45μm	
Frame Rate	30.5fps@4096 × 3000	
ADC Bit Depth	12bit	
Pixel Bit Depth	8bit, 12bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer RG8/Bayer RG12	Mono8/Mono12
Signal Noise Ratio	40.27dB	40.38dB
Exposure Time	UltraShort: 1μs~100μs, Actual Steps: 1μs Standard: 28μs~1s, Actual Steps: 1 row period	
Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB	
Binning	1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4	
Decimation	Sensor: 1×1, 2×2	
Synchronization	Hardware trigger, software trigger	
I/O	1 input and 1 output with opto-isolated, 2 programmable GPIOs	
Operating Temp.	0°C~45°C	
Storage Temp.	-20°C~70°C	
Operating Humidity	10%~80%	
Typical Power	3.05W@5V	
Power Requirements	Power over USB3.0	
Lens Mount	C	
Data Interface	USB3.0	
Dimensions	36mm×31mm×38.8mm (without lens adapter or connectors)	
Weight	66g	
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8	

Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity
Conformity	CE, RoHS, FCC, ICES, UKCA, USB3 Vision, GenICam

Table 4-51 ME2P-1230-30U3M/C-HS camera specifications

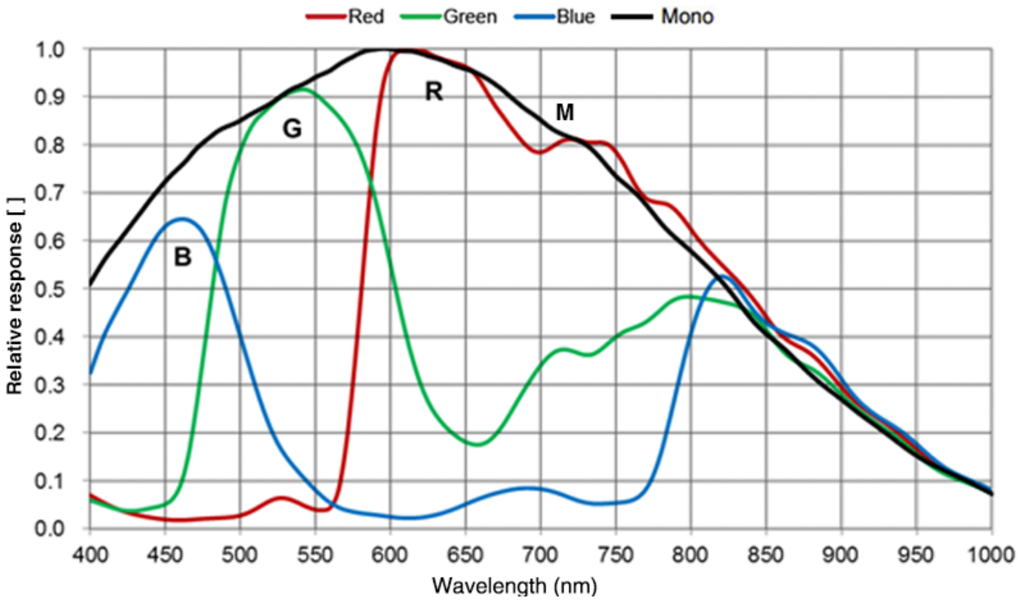


Figure 4-54 ME2P-1230-30U3M/C-HS sensor spectral response

4.7. ME2L-U3(-L) Series

4.7.1. ME2L-042-121U3M/C(-L)

Specifications	ME2L-042-121U3C ME2L-042-121U3C-L	ME2L-042-121U3M ME2L-042-121U3M-L
Resolution	720 × 540	
Sensor	Sony IMX297 global shutter CMOS	
Max. Image Circle	1/2.9 inch	
Pixel Size	6.9μm × 6.9μm	
Frame Rate	121.8fps@720 × 540	
ADC Bit Depth	10bit	
Pixel Bit Depth	8bit, 10bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer RG8/Bayer RG10	Mono8/Mono10
Signal Noise Ratio	43.55dB	43.57dB
Exposure Time	Standard: 20μs~1s, Actual Steps: 1 row period	

Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB
Binning	N/A
Decimation	N/A
Synchronization	Hardware trigger (ME2L-U3-L: N/A), software trigger
I/O	1 input with opto-isolated, 1 programmable GPIO (ME2L-U3-L: N/A)
Operating Temp.	0°C~45°C
Storage Temp.	-20°C~70°C
Operating Humidity	10%~80%
Typical Power	1.18W@5V
Power Requirements	Power over USB3.0
Lens Mount	C
Data Interface	USB3.0
Dimensions	29mm×29mm×29mm (without lens adapter or connectors)
Weight	ME2L-U3: 47g, ME2L-U3-L: 44g
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8
Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity (ME2L-U3-L not support trigger polarity and flash polarity)
Conformity	CE, RoHS, FCC, ICES, UKCA, USB3 Vision, GenICam

Table 4-52 ME2L-042-121U3M/C(-L) camera specifications

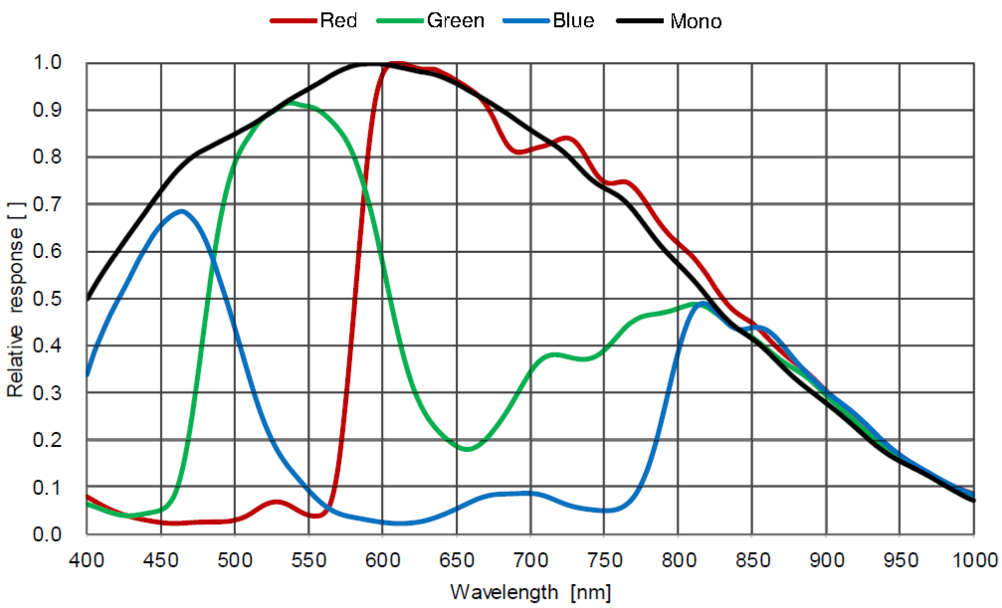


Figure 4-55 ME2L-042-121U3M/C(-L) sensor spectral response

4.7.2. ME2L-161-61U3M/C(-L)

Specifications	ME2L-161-61U3C ME2L-161-61U3C-L	ME2L-161-61U3M ME2L-161-61U3M-L
Resolution	1440 × 1080	
Sensor	Sony IMX296 global shutter CMOS	
Max. Image Circle	1/2.9 inch	
Pixel Size	3.45μm × 3.45μm	
Frame Rate	61.2fps@1440 × 1080	
ADC Bit Depth	10bit	
Pixel Bit Depth	8bit, 10bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer RG8/Bayer RG10	Mono8/Mono10
Signal Noise Ratio	40.23dB	40.6dB
Exposure Time	Standard: 20μs~1s, Actual Steps: 1 row period	
Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB	
Binning	N/A	
Decimation	N/A	
Synchronization	Hardware trigger (ME2L-U3-L: N/A), software trigger	
I/O	1 input with opto-isolated, 1 programmable GPIO (ME2L-U3-L: N/A)	
Operating Temp.	0°C~45°C	
Storage Temp.	-20°C~70°C	
Operating Humidity	10%~80%	
Typical Power	1.21W@5V	
Power Requirements	Power over USB3.0	
Lens Mount	C	
Data Interface	USB3.0	
Dimensions	29mm×29mm×29mm (without lens adapter or connectors)	
Weight	ME2L-U3: 47g, ME2L-U3-L: 44g	
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8	

Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity (ME2L-U3-L not support trigger polarity and flash polarity)
Conformity	CE, RoHS, FCC, ICES, UKCA, USB3 Vision, GenICam

Table 4-53 ME2L-161-61U3M/C(-L) camera specifications

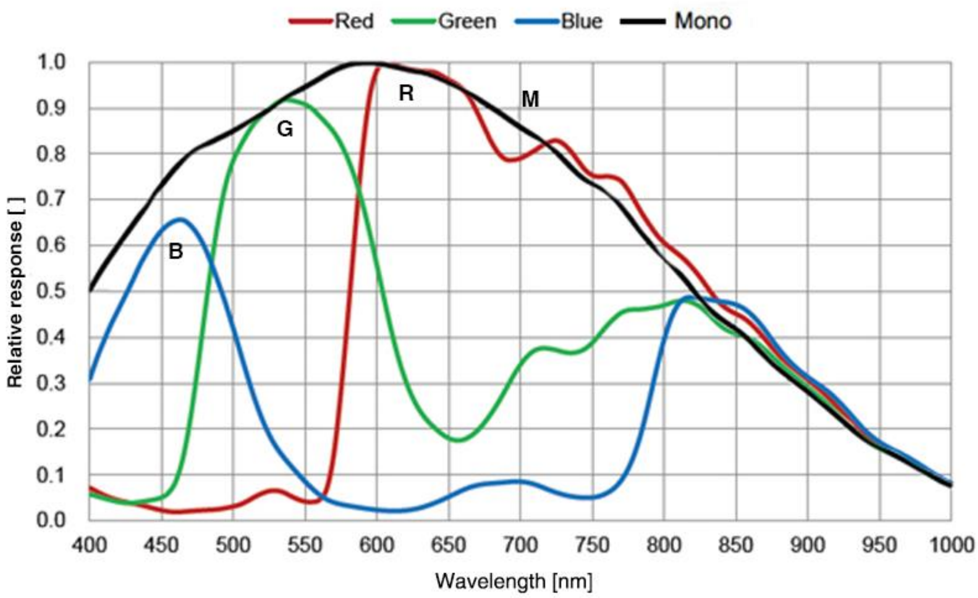


Figure 4-56 ME2L-161-61U3M/C(-L) sensor spectral response

4.7.3. ME2L-203-76U3M/C(-L)

Specifications	ME2L-203-76U3C ME2L-203-76U3C-L	ME2L-203-76U3M ME2L-203-76U3M-L
Resolution	1920 × 1080	
Sensor	rolling shutter CMOS	
Max. Image Circle	1/2.8 inch	
Pixel Size	2.9μm × 2.9μm	
Frame Rate	76fps@1920 × 1080	
ADC Bit Depth	10bit	
Pixel Bit Depth	8bit, 10bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer RG8/Bayer RG10	Mono8/Mono10
Signal Noise Ratio	41.53dB	41.26dB
Exposure Time	Standard: 20μs~1s, Actual Steps: 1 row period	
Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB	
Binning	N/A	

Decimation	N/A
Synchronization	Hardware trigger (ME2L-U3-L: N/A), software trigger
I/O	1 input with opto-isolated, 1 programmable GPIO (ME2L-U3-L: N/A)
Operating Temp.	0°C~45°C
Storage Temp.	-20°C~70°C
Operating Humidity	10%~80%
Typical Power	1.53W@5V
Power Requirements	Power over USB3.0
Lens Mount	C
Data Interface	USB3.0
Dimensions	29mm×29mm×29mm (without lens adapter or connectors)
Weight	ME2L-U3: 47g, ME2L-U3-L: 44g
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8
Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity (ME2L-U3-L not support trigger polarity and flash polarity)
Conformity	CE, RoHS, FCC, ICES, UKCA, USB3 Vision, GenICam

Table 4-54 ME2L-203-76U3M/C(-L) camera specifications

4.7.4. ME2L-204-76U3M/C(-L)-F02

Specifications	ME2L-204-76U3C-F02 ME2L-204-76U3C-L-F02	ME2L-204-76U3M-F02 ME2L-204-76U3M-L-F02
Resolution	1920 × 1080	
Sensor	rolling shutter CMOS	
Max. Image Circle	1/2.8 inch	
Pixel Size	2.9μm × 2.9μm	
Frame Rate	76fps@1920 × 1080	
ADC Bit Depth	10bit	
Pixel Bit Depth	8bit, 10bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer RG8/Bayer RG10	Mono8/Mono10
Signal Noise Ratio	40.9dB	40.67dB
Exposure Time	Standard: 20μs~1s, Actual Steps: 1 row period	
Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB	

Binning	N/A
Decimation	N/A
Synchronization	Hardware trigger (ME2L-U3-L: N/A), software trigger
I/O	1 input with opto-isolated, 1 programmable GPIO (ME2L-U3-L: N/A)
Operating Temp.	0°C~45°C
Storage Temp.	-20°C~70°C
Operating Humidity	10%~80%
Typical Power	1.27W@5V
Power Requirements	Power over USB3.0
Lens Mount	C
Data Interface	USB3.0
Dimensions	29mm×29mm×29mm (without lens adapter or connectors)
Weight	ME2L-U3: 47g, ME2L-U3-L: 44g
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8
Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity (ME2L-U3-L not support trigger polarity and flash polarity)
Conformity	CE, RoHS, FCC, ICES, UKCA, USB3 Vision, GenICam

Table 4-55 ME2L-204-76U3M/C(-L)-F02 camera specifications

4.7.5. ME2L-505-36U3M/C(-L)

Specifications	ME2L-505-36U3C ME2L-505-36U3C-L	ME2L-505-36U3M ME2L-505-36U3M-L
Resolution	2592 × 1944	
Sensor	Sony IMX335 rolling shutter CMOS	
Max. Image Circle	1/2.8 inch	
Pixel Size	2.0μm × 2.0μm	
Frame Rate	36.9fps@2592 × 1944	
ADC Bit Depth	10bit	
Pixel Bit Depth	8bit, 10bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer RG8/Bayer RG10	Mono8/Mono10
Signal Noise Ratio	39.29dB	39.43dB
Exposure Time	Standard: 20μs~1s, Actual Steps: 1 row period	

Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB
Binning	N/A
Decimation	N/A
Synchronization	Hardware trigger (ME2L-U3-L: N/A), software trigger
I/O	1 input with opto-isolated, 1 programmable GPIO (ME2L-U3-L: N/A)
Operating Temp.	0°C~45°C
Storage Temp.	-20°C~70°C
Operating Humidity	10%~80%
Typical Power	1.27W@5V
Power Requirements	Power over USB3.0
Lens Mount	C
Data Interface	USB3.0
Dimensions	29mm×29mm×29mm (without lens adapter or connectors)
Weight	ME2L-U3: 47g, ME2L-U3-L: 44g
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8
Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity (ME2L-U3-L not support trigger polarity and flash polarity)
Conformity	CE, RoHS, FCC, ICES, UKCA, USB3 Vision, GenICam

Table 4-56 ME2L-505-36U3M/C(-L) camera specifications

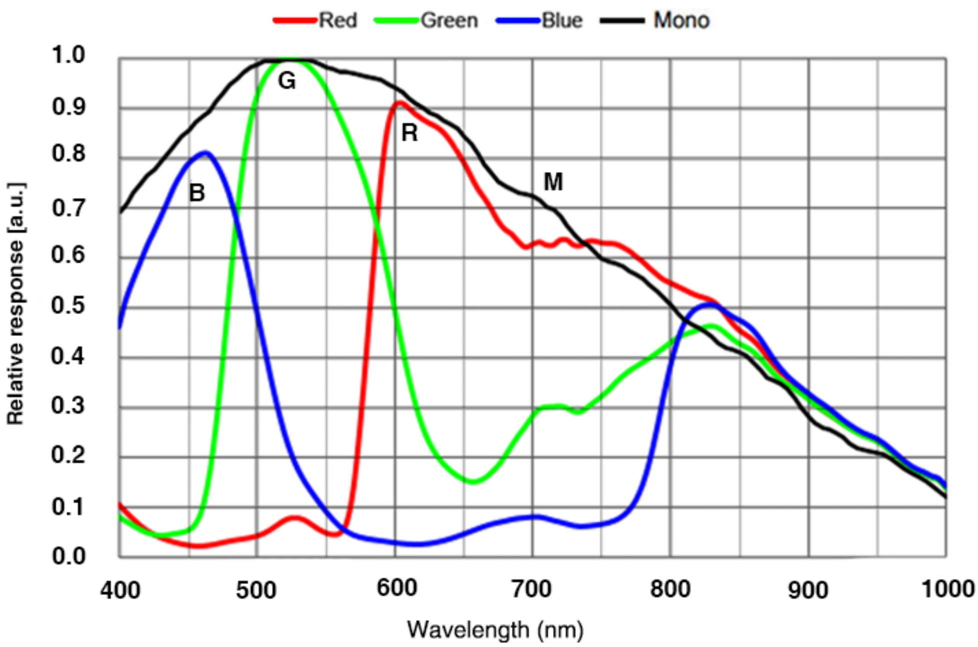


Figure 4-57 ME2L-505-36U3M/C(-L) sensor spectral response

4.7.6. ME2L-830-22U3M/C(-L)

Specifications	ME2L-830-22U3C ME2L-830-22U3C-L	ME2L-830-22U3M ME2L-830-22U3M-L
Resolution	3840 × 2160	
Sensor	Sony IMX334 rolling shutter CMOS	
Max. Image Circle	1/1.8 inch	
Pixel Size	2.0μm × 2.0μm	
Frame Rate	22.1fps@3840 × 2160	
ADC Bit Depth	12bit	
Pixel Bit Depth	8bit, 10bit	
Mono/Color	Color	Mono
Pixel Formats	Bayer RG8/Bayer RG10	Mono8/Mono10
Signal Noise Ratio	39.41dB	39.36dB
Exposure Time	Standard: 20μs~1s, Actual Steps: 1 row period	
Gain	0dB~24dB, Default: 0dB, Steps: 0.1dB	
Binning	N/A	
Decimation	N/A	
Synchronization	Hardware trigger (ME2L-U3-L: N/A), software trigger	
I/O	1 input with opto-isolated, 1 programmable GPIO (ME2L-U3-L: N/A)	
Operating Temp.	0°C~45°C	
Storage Temp.	-20°C~70°C	
Operating Humidity	10%~80%	
Typical Power	1.33W@5V	
Power Requirements	Power over USB3.0	
Lens Mount	C	
Data Interface	USB3.0	
Dimensions	29mm×29mm×29mm (without lens adapter or connectors)	
Weight	ME2L-U3: 47g, ME2L-U3-L: 44g	
Operating System	Windows 7/10/11 32/64bit, Linux, Android, ARMv7, ARMv8	

Programmable Control	Image size, gain, exposure time, trigger polarity, flash polarity (ME2L-U3-L not support trigger polarity and flash polarity)
Conformity	CE, RoHS, FCC, ICES, UKCA, USB3 Vision, GenICam

Table 4-57 ME2L-830-22U3M/C(-L) camera specifications

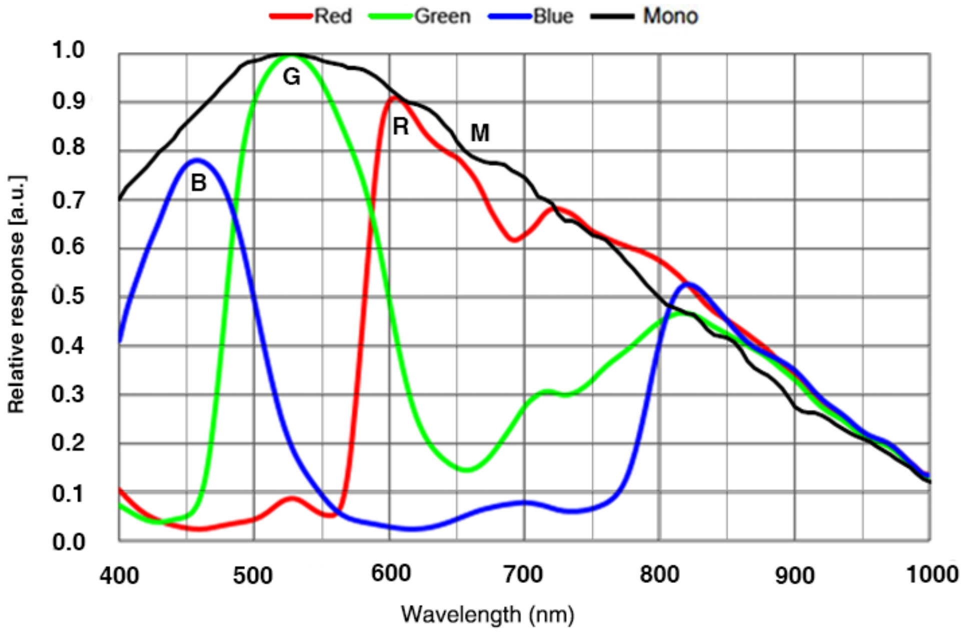


Figure 4-58 ME2L-830-22U3M/C(-L) sensor spectral response

5. Dimensions

5.1. Camera Dimensions

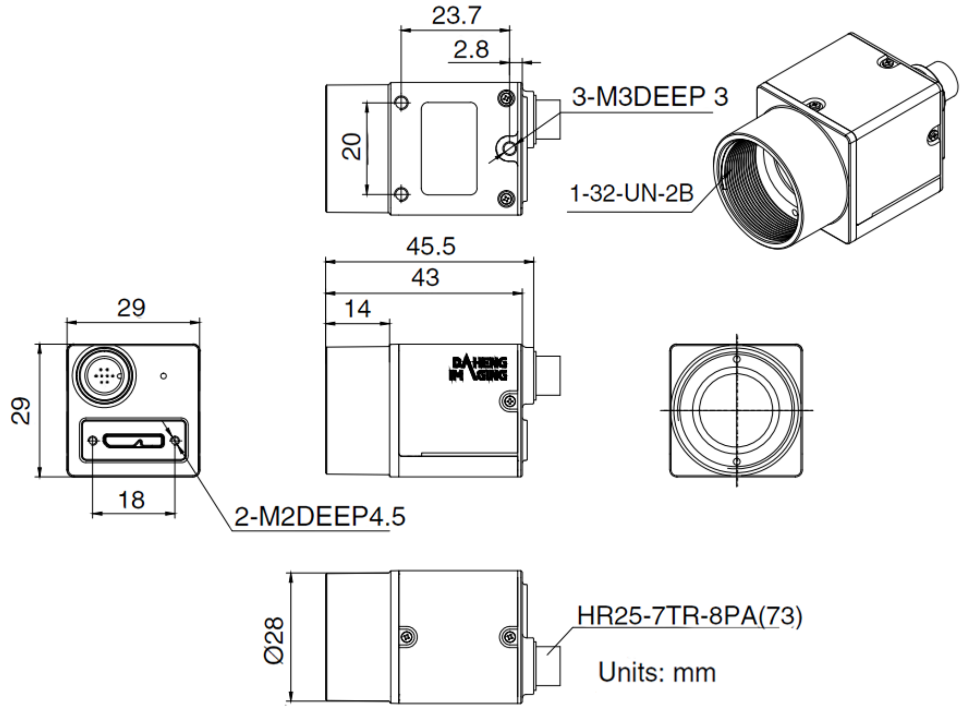


Figure 5-1 MER2-U3 mechanical dimensions

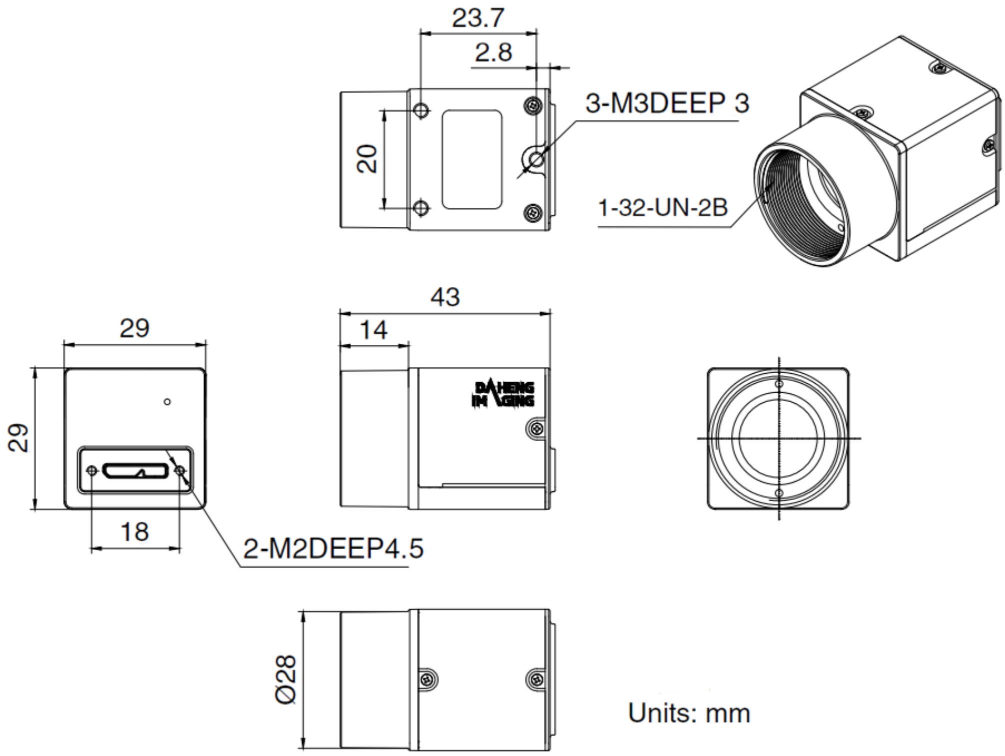


Figure 5-2 MER2-U3-L mechanical dimensions

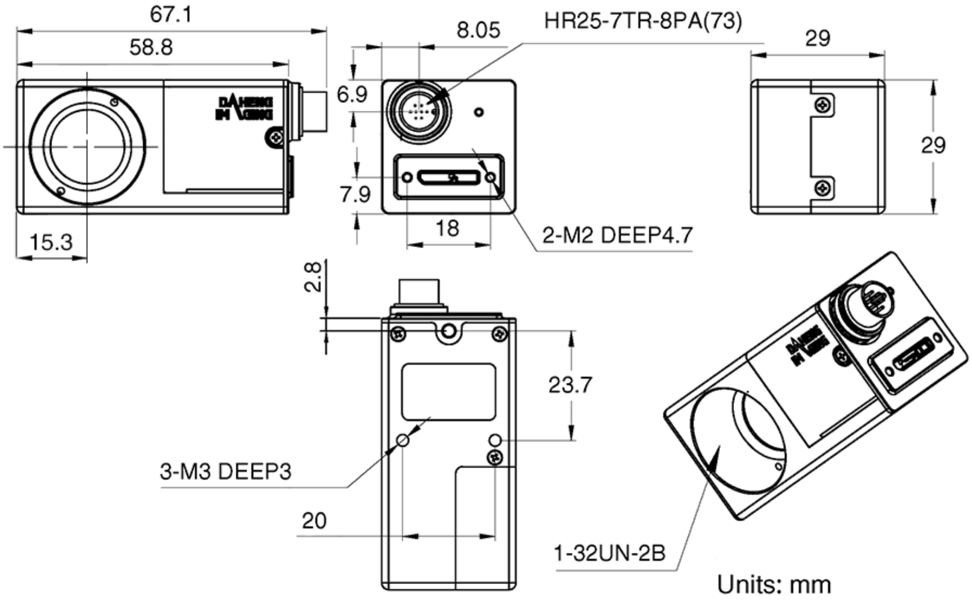


Figure 5-3 MER2-U3-W90 mechanical dimensions

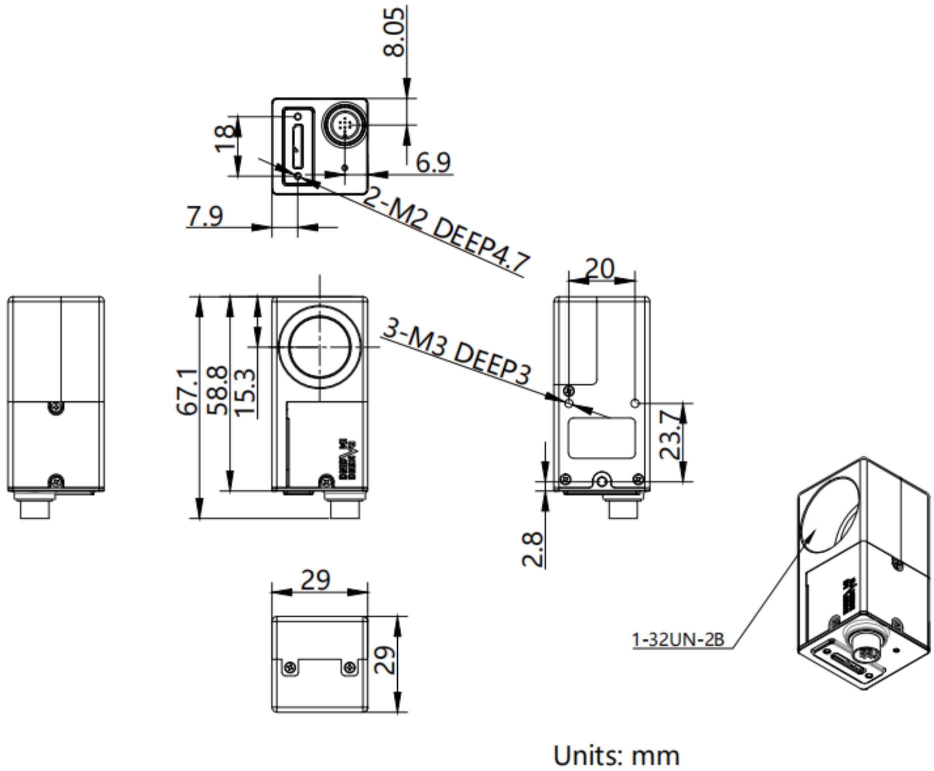


Figure 5-4 MER2-U3-W90-S90 mechanical dimensions

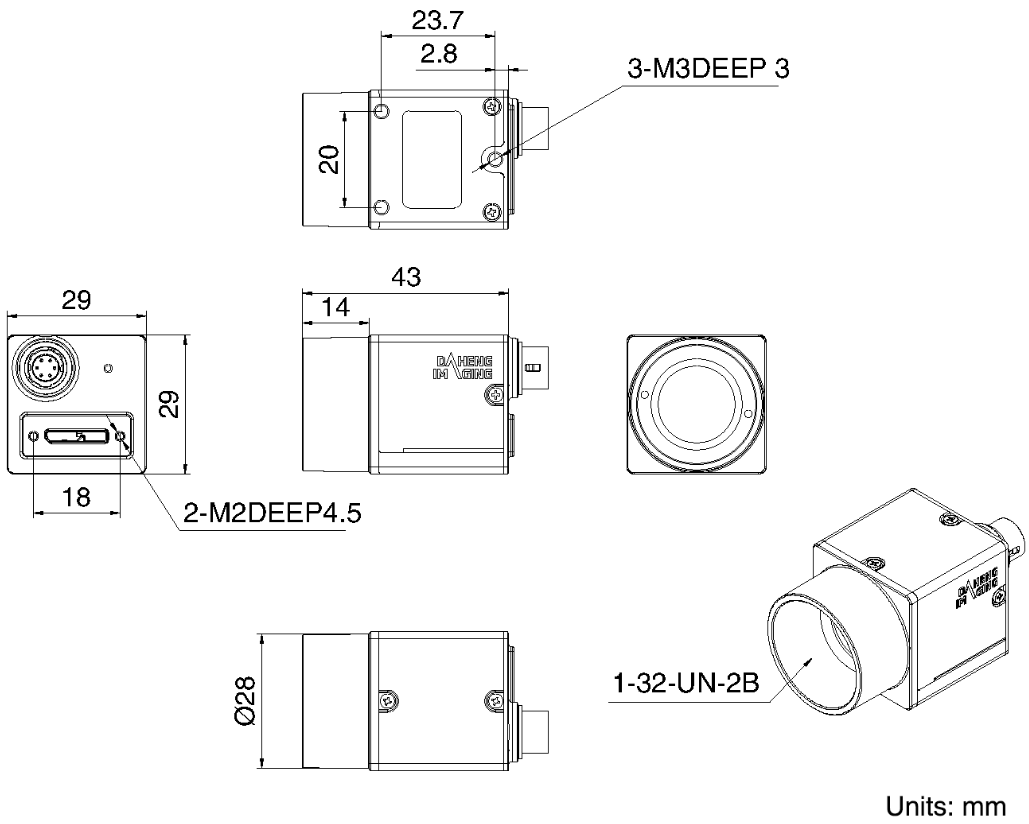


Figure 5-5 MER2-U3-6P mechanical dimensions

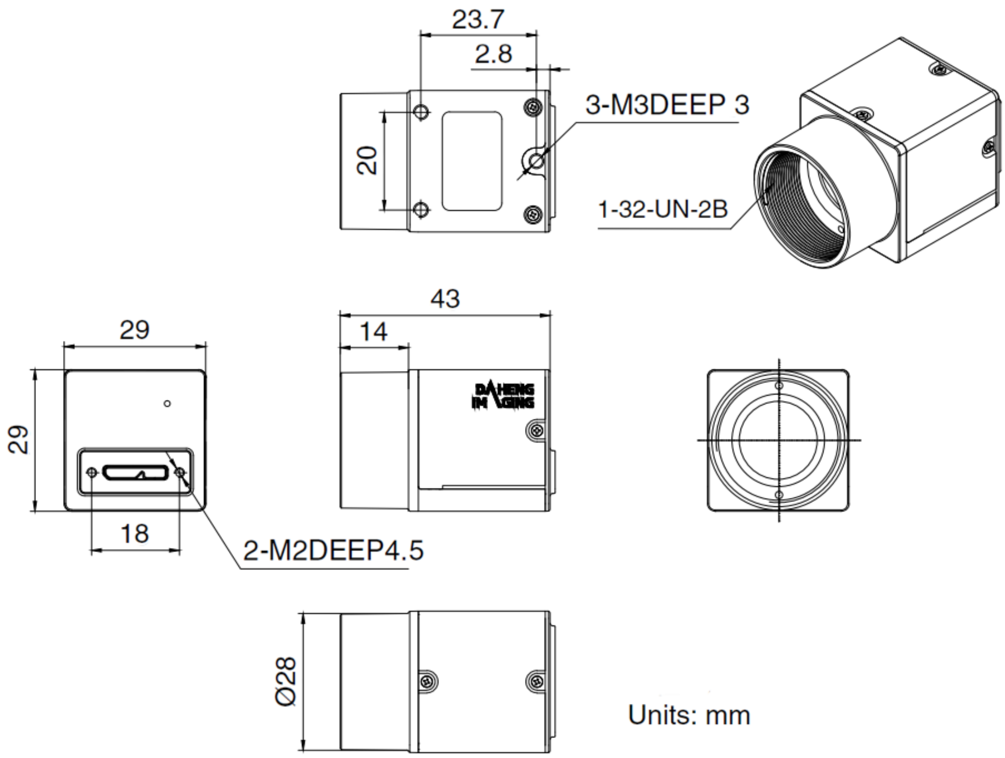


Figure 5-6 MER2-U3-L-6P mechanical dimensions

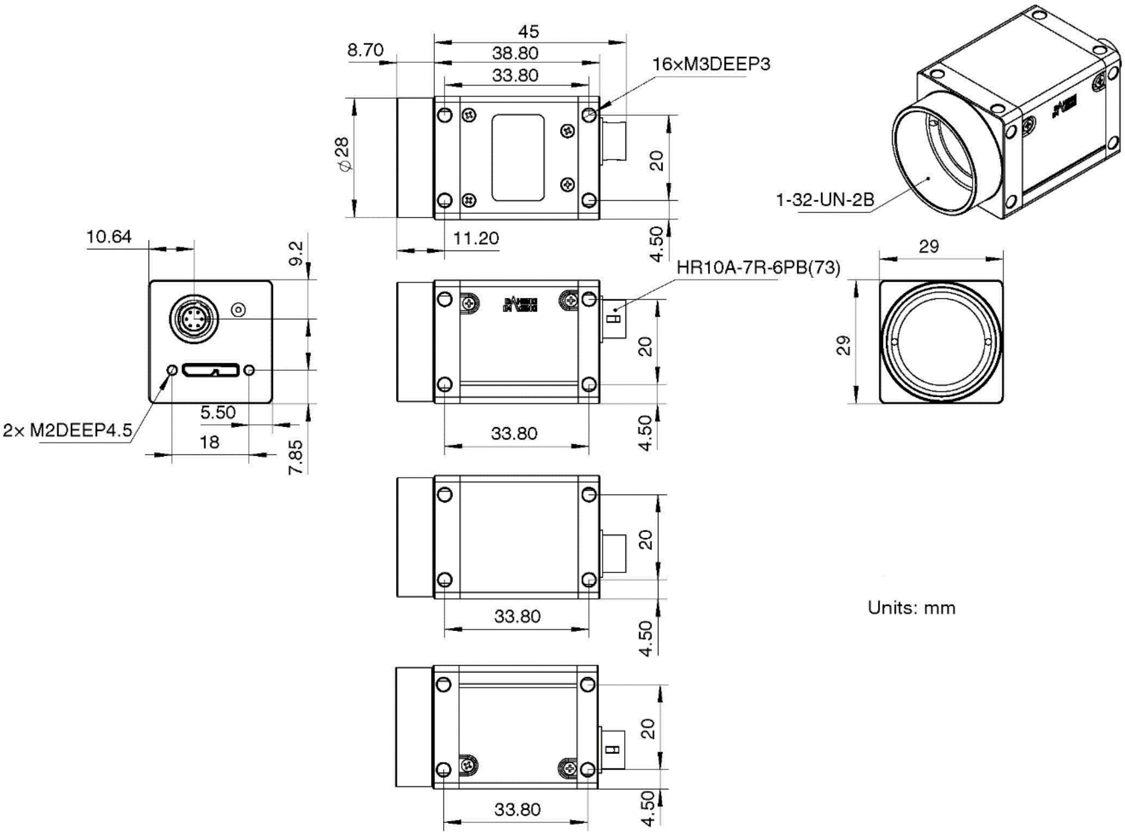


Figure 5-7 ME2S-U3 mechanical dimensions

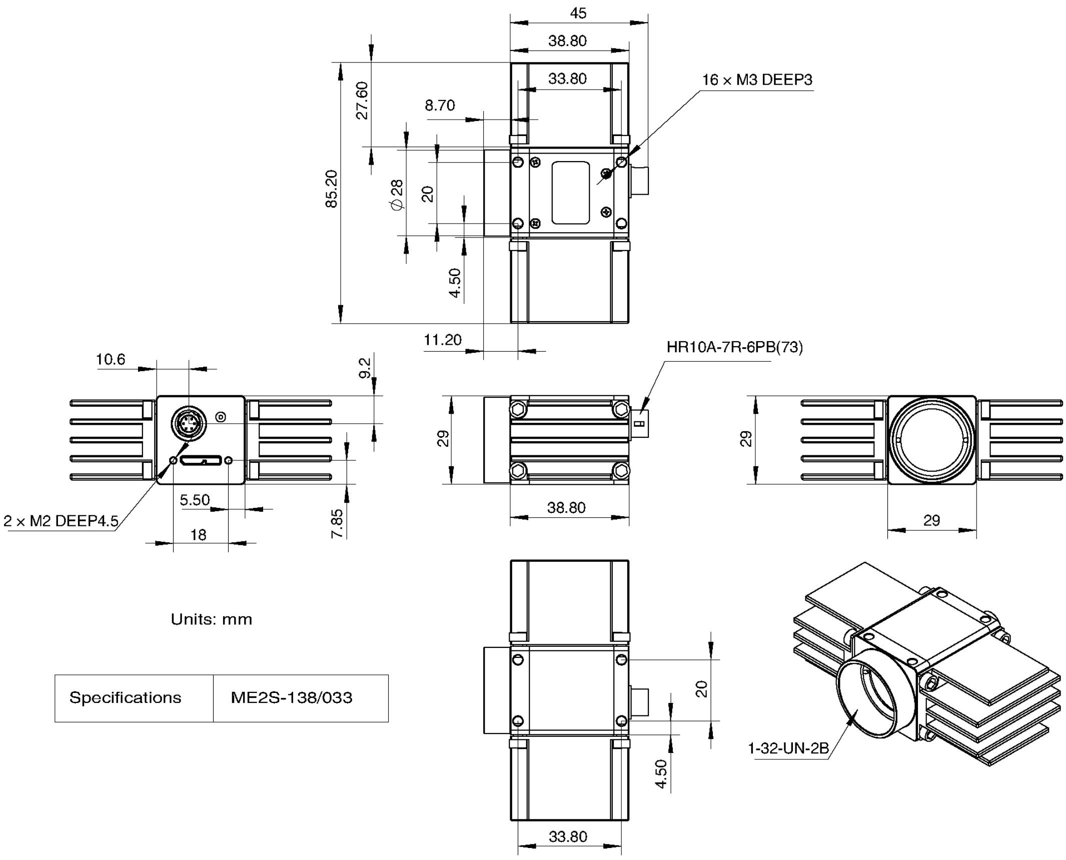


Figure 5-8 ME2S-U3 mechanical dimensions (With Heat Dissipation Fins)

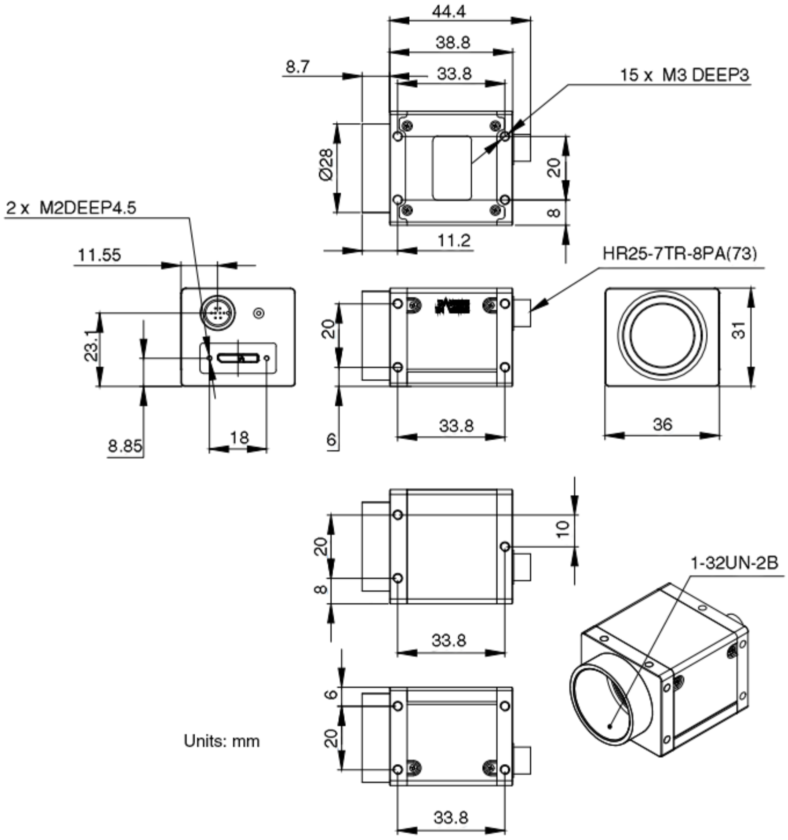


Figure 5-9 ME2P-U3 mechanical dimensions

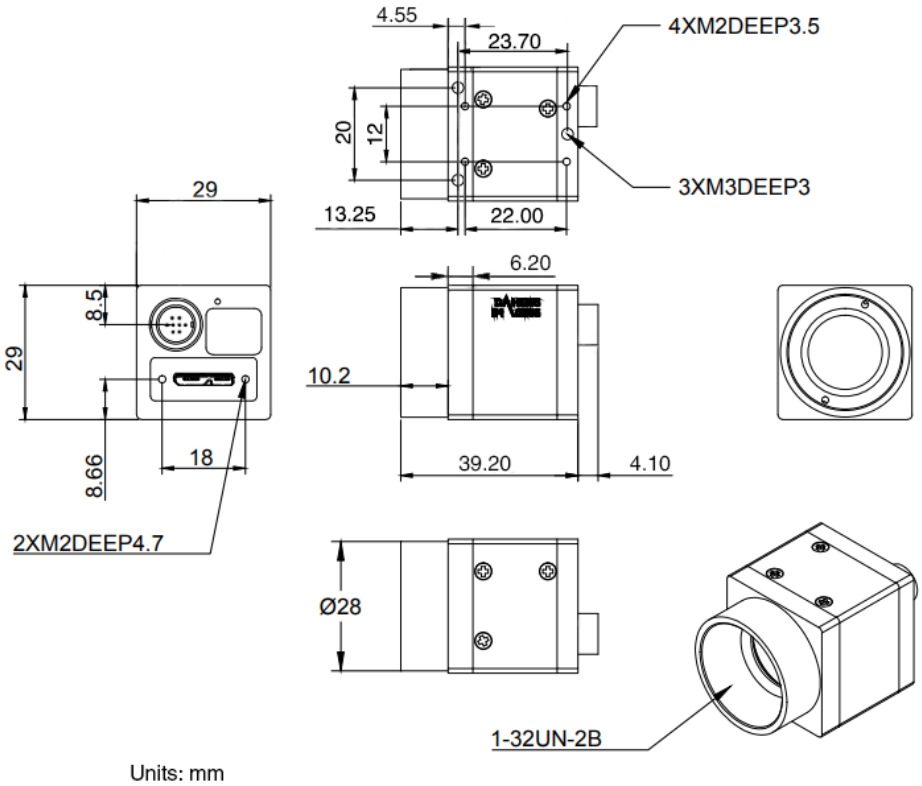


Figure 5-10 ME2L-U3 mechanical dimensions

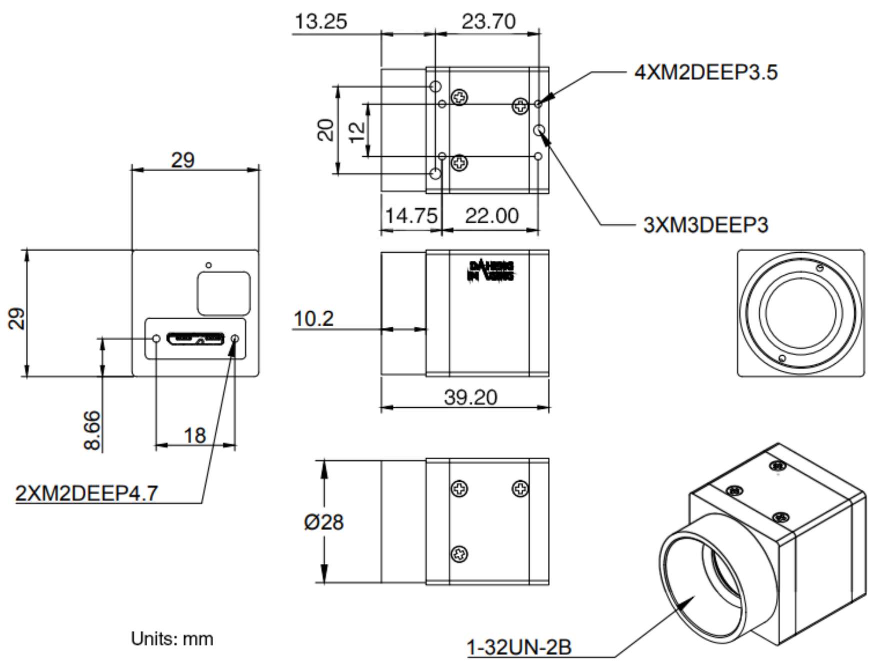


Figure 5-11 ME2L-U3-L mechanical dimensions

5.2. Optical Interface

The cameras are equipped with C-mount lens adapters. The back-flange distance is 17.526 mm (in the air). The maximum lens allowed thread length of ME2P and MER2 cameras should be less than 11.3mm, as shown in Figure 5-12. The maximum lens allowed thread length of ME2L cameras should be less than 9.4mm, as shown in Figure 5-13. And the maximum lens allowed thread length of ME2S cameras should be less than 10.15mm, as shown in Figure 5-14.

The color models are equipped with an IR filter and the cut-off frequency is 700nm. The mono models are equipped with a transparent glass. Remove IR-filter or transparent glass will defocus the image plane.

Contact our technical support when the glass needed to be removed.

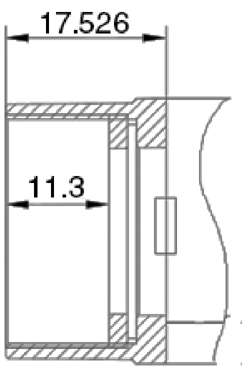


Figure 5-12 C-mount optical interface of ME2P/MER2

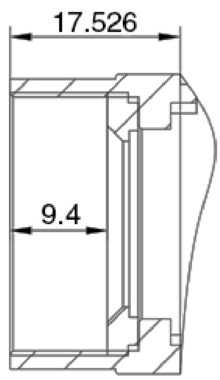


Figure 5-13 C-mount optical interface of ME2L

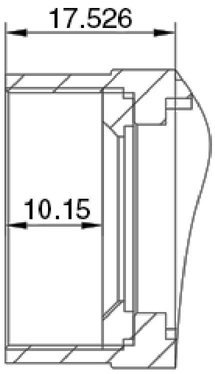


Figure 5-14 C-mount optical interface of ME2S

5.3. Tripod Adapter Dimensions

When customizing the tripod adapter, you need to consider the relationship between tripod adapter, screw length and step thickness of tripod adapter.

1) Screw length = tripod adapter step thickness + spring washer thickness + screwing length of camera screw thread

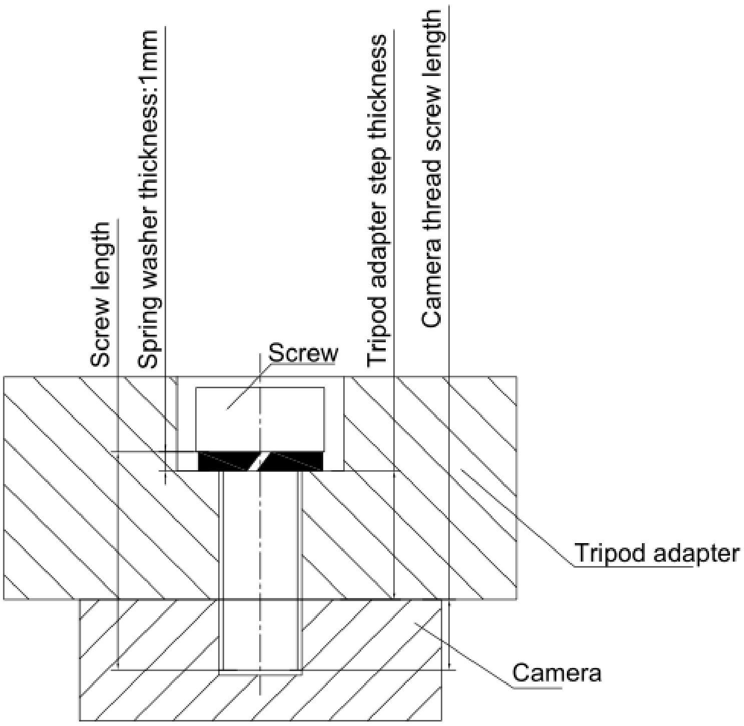


Figure 5-15 Schematic diagram of screw specification, tripod adapter step thickness and spring washer thickness

2) It is recommended that you select the screw specifications and the tripod adapter step thickness from the table below:

Screw specification	Tripod adapter step thickness (mm)	Spring washer thickness (mm)	Screwing length of camera screw thread (mm)
M3*6 hexagon socket head cap screw	2.5	0.8	2.7
M3*8 hexagon socket head cap screw	4.5	0.8	2.7
M3*10 hexagon socket head cap screw	6.5	0.8	2.7
M2*4 hexagon socket head cap screw	1.1	0.6	2.3
M2*5 hexagon socket head cap screw	2.1	0.6	2.3
M2*6 hexagon socket head cap screw	3.1	0.6	2.3

If the screw specification and the thickness of the tripod adapter do not conform to the above table, it may cause the camera thread hole through or thread stripping.

6. Filters and Lenses

6.1. Filters

The MERCURY2 color models are equipped with IR filters. The monochrome models are equipped with transparent glasses.

Contact our technical support when the glass needed to be removed.

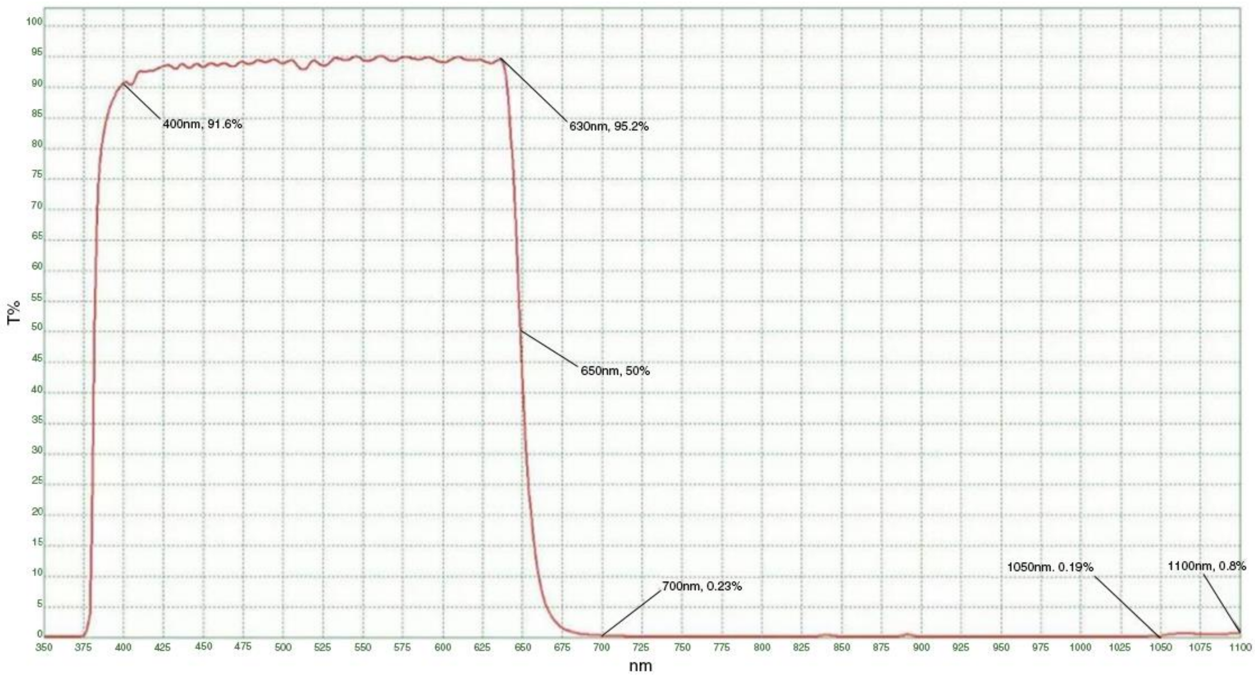


Figure 6-1 Infrared cut-off filter transmittance curve for MERCURY2 color camera

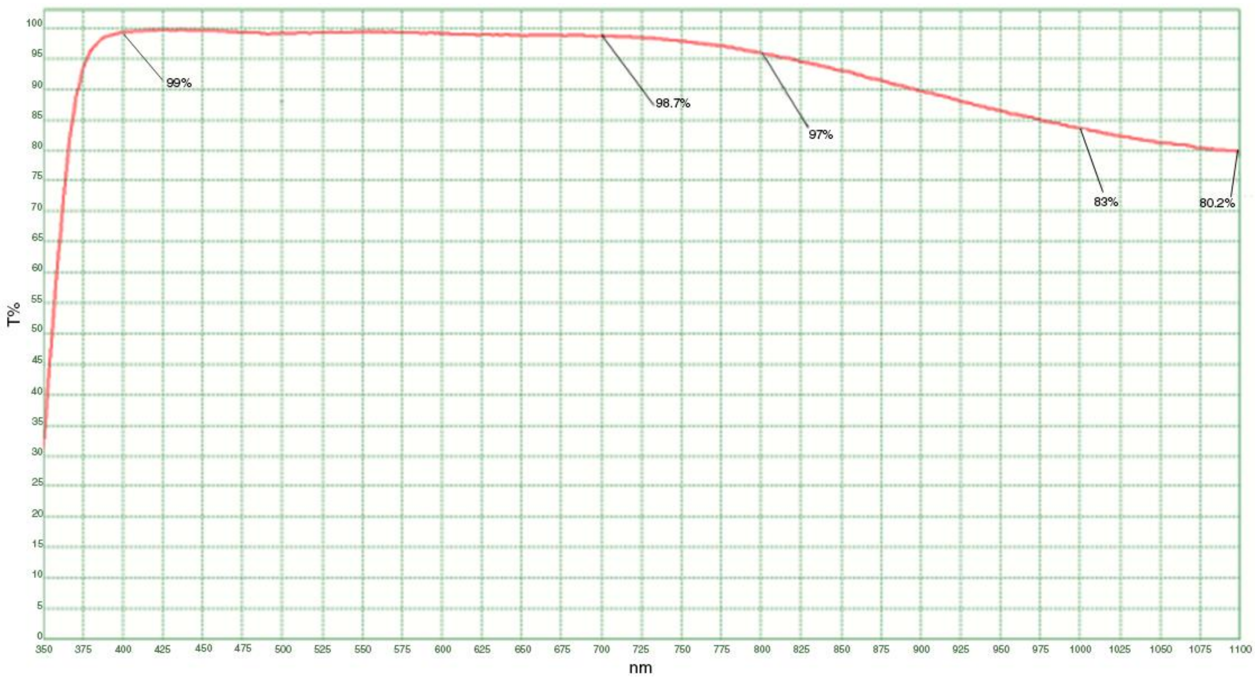


Figure 6-2 Transparent glass transmittance curve for MERCURY2 mono camera

6.2. Lens Selection Reference

DAHENG IMAGING is a professional supplier for images and machine vision devices in China. In addition to industrial cameras, it also provides high-resolution, high-optical machine vision lenses for a wide range of industrial cameras on the market.

In order to meet the requirements of machine vision for high resolution and low distortion, DAHENG IMAGING released eight series of industrial lenses, resolution from 2 megapixels to 25 megapixels, with small size, light weight, high resolution and low distortion rate, etc.

When choosing a lens, there are several factors to consider:

1) Mount

- According to the connection methods of the lens and the camera, the commonly used mounts are C, CS, F, V, Leica, M42, M58, M72, M90, and so on
- The MERCURY2 USB3.0 Vision industry camera is equipped with a standard C-Mount. When selecting a lens, select the lens of the same mount as the camera

2) Max. Image Circle

- The maximum sensor size that the lens image can cover. There are mainly 1/2", 2/3", 1/1.2", 1", 1.1", 4/3", and so on
- When selecting a lens, make sure that the Max. Image Circle of the lens is not smaller than the sensor size of the industry camera

3) Resolution

- The resolution represents the ability of the lens to record the details of the object, usually in units of line pairs that can be resolved per millimeter: line pair/mm (lp/mm). The higher the resolution of the lens, the sharper the image
- When selecting a lens, make sure that the accuracy required by the system is less than the resolution of the lens

4) Working distance

- The distance from the first working surface of the lens to the object being measured
- When selecting a lens, make sure that the working distance is larger than the lens parameter “minimum object distance”

5) Focal length

- The focal length is the distance from the center point of the lens to the clear image formed on the focal plane. The smaller the focal length, the larger the field of view of the industry camera
- For focal length calculation, we need to confirm three parameters: the field of view, the sensor size of the industry camera and the working distance. The focal length (f) of the expected lens can be calculated by the following formula

f = sensor size (horizontal or vertical) * Working distance / Field of View (corresponding to the horizontal or vertical direction of the sensor size)

The corresponding lens is selected by the calculated focal length.

6.2.1. HN-2M Series Prime Lenses

The HN-2M series lenses are 2 megapixels lenses for industrial, suitable for sensors with max. image circle of 1/2" ~ 2/3". This series of lenses has the following features:

- High optical performance with optical design supporting up to 2/3" sensor size, 6.2μm pixel size (up to 2 megapixels) sensor. 8 models with F values below 2.8, clear images can be obtained even in low light environment
- Excellent anti-shock and anti-vibration performance, with a unique mechanical structure, the optical axis fluctuates below 10μm
- The housing is small and compact, the minimum outer diameter is only ϕ29.5mm, and it can be installed in various limited spaces
- Easy to install, there are 3 fixing holes on the lens barrel for fixing the iris and focusing. The best fixing hole can be selected according to the installation environment

Models:

- HN-0612-2M-C1/2X
- HN-0914-2M-C2/3X
- HN-12.514-2M-C2/3X
- HN-1614-2M-C2/3X
- HN-2514-2M-C2/3X
- HN-3516-2M-C2/3X
- HN-5023-2M-C2/3X
- HN-7528-2M-C2/3X

6.2.2. HN-5M Series Prime Lenses

The HN-5M series lenses are 5 megapixels lenses for industrial, suitable for sensors with max. image circle of 2/3" ~ 1.1". This series of lenses has the following features:

- 5 megapixels resolution, the definition is consistent from the center to the periphery, greatly improving the distance between iris and photography
- The housing is small and compact, the minimum outer diameter is only ϕ29.5mm, and it can be installed in various limited spaces
- Easy to install, there are 3 fixing holes on the lens barrel for fixing the iris and focusing. The best fixing hole can be selected according to the installation environment

Models:

- HN-0619-5M-C2/3X
- HN-0816-5M-C2/3X
- HN-1216-5M-C2/3X
- HN-1616-5M-C2/3X
- HN-2516-5M-C2/3X
- HN-3519-5M-C2/3X
- HN-5024-5M-C2/3X

6.2.3. HN-6M Series Prime Lenses

The HN-6M series lenses are 6 megapixels lenses for industrial, suitable for sensors with max. image circle of 2/3". This series of lenses has the following features:

- 6 megapixels resolution, 5~75mm focal length available
- Stable performance at long working distance
- Compact and robust
- Up to 5G of anti-vibration performance

Models:

- HN-0528-6M-C2/3B
- HN-0828-6M-C2/3B
- HN-1228-6M-C2/3B
- HN-1628-6M-C2/3B
- HN-2528-6M-C2/3B
- HN-3528-6M-C2/3B
- HN-5028-6M-C2/3B
- HN-7528-6M-C2/3B

6.2.4. HN-20M Series Prime Lenses

The HN-20M series lenses are 20 megapixels lenses for industrial, suitable for sensors with max. image circle of 1". This series of lenses has the following features:

- 20 megapixels resolution, 8~75mm focal length available
- Ultra-low optical distortion and excellent uniformity of brightness
- Stable performance at different working distance by floating design
- The housing is small and compact, up to 5G of anti-vibration performance
- The definition is consistent from the center to the periphery, greatly improving the distance between iris and photography

Models:

- HN-0826-20M-C1/1X
- HN-1226-20M-C1/1X
- HN-1624-20M-C1/1X
- HN-2520-20M-C1/1X
- HN-3522-20M-C1/1X
- HN-5024-20M-C1/1X
- HN-7531-20M-C1/1X

6.2.5. HN-P-6M Series Prime Lenses

The HN-P-6M series lenses are 6 megapixels lenses for industrial, suitable for sensors with max. image circle of 1/1.8" ~ 2/3". This series of lenses has the following features:

- 6 megapixels resolution, 6~50mm focal length available
- The housing is small and compact, the minimum outer diameter is only ϕ33.0mm, and it can be installed in various limited spaces
- Ultra-low optical distortion, greatly improving the accuracy and stability

Models:

- HN-P-0628-6M-C1/1.8
- HN-P-0828-6M-C1/1.8
- HN-P-1228-6M-C1/1.8
- HN-P-1628-6M-C1/1.8
- HN-P-2528-6M-C1/1.8
- HN-P-3528-6M-C1/1.8
- HN-P-5028-6M-C1/1.8
- HN-P-0828-6M-C2/3
- HN-P-1228-6M-C2/3
- HN-P-1628-6M-C2/3
- HN-P-2528-6M-C2/3
- HN-P-3528-6M-C2/3

6.2.6. HN-P-10M Series Prime Lenses

The HN-P-10M series lenses are 10 megapixels lenses for industrial, suitable for sensors with max. image circle of 2/3". This series of lenses has the following features:

- 10 megapixels resolution, 8~50mm focal length available
- 2.4μm small pixel size, F1.8 large aperture design
- The housing is small and compact, the minimum outer diameter is only ϕ32.0mm, and it can be installed in various limited spaces
- Ultra-low optical distortion

Models:

- HN-P-0824-10M-C2/3
- HN-P-1220-10M-C2/3
- HN-P-1618-10M-C2/3
- HN-P-2518-10M-C2/3
- HN-P-3520-10M-C2/3
- HN-P-5028-10M-C2/3

6.2.7. HN-P-20M Series Prime Lenses

The HN-P-20M series lenses are 20 megapixels lenses for industrial, with max. image circle of 1.1". This series of lenses has the following features:

- 20 megapixels resolution, 12~50mm focal length available
- 2.4μm small pixel size, F2.4 large aperture design
- Miniaturized structure
- Ultra-low optical distortion

Models:

- HN-P-1224-20M-C1.1/1
- HN-P-1624-20M-C1.1/1
- HN-P-2524-20M-C1.1/1
- HN-P-3524-20M-C1.1/1
- HN-P-5024-20M-C1.1/1

6.2.8. HN-P-25M Series Prime Lenses

The HN-P-25M series lenses are 25 megapixels lenses for industrial, suitable for sensors with max. image circle of 1.2". This series of lenses has the following features:

- 25 megapixels resolution, 12~50mm focal length available
- 2.74μm small pixel size, F2.4 large aperture design
- Small and compact
- Ultra-low optical distortion

Models:

- HN-P-1224-25M-C1.2/1
- HN-P-1624-25M-C1.2/1
- HN-P-2524-25M-C1.2/1
- HN-P-3524-25M-C1.2/1
- HN-P-5024-25M-C1.2/1

7. Electrical Interface

7.1. LED Light

7.1.1. MER2/ME2P/ME2L Series

An LED light is set on the back cover of camera which indicates camera's status, as shown in Table 7-1. LED light can display 3 colors: red, yellow and green.

LED status	Camera status
Off	The camera is powered off
Solid red	The camera is not boot-loaded
Flashing red	The camera is in low power consumption mode
Solid green	The camera has been boot-loaded, but no data is being transmitted
Flashing green	Data is being transmitted
Flashing yellow	The camera's initialization failed

Table 7-1 Camera status

7.1.2. ME2S Series

An LED light is set on the back cover of camera which indicates camera's status, as shown in Table 7-1. LED light can display 3 colors: red, yellow and green.

LED status	Camera status
Off	The camera is powered off or only USB3.0 interface/external power supply is power on
Solid red	The camera is not boot-loaded
Flashing red	The camera is in low power consumption mode
Solid green	The camera has been boot-loaded, but no data is being transmitted
Flashing green	Data is being transmitted
Flashing yellow	The camera's initialization failed

Table 7-2 Camera status

7.2. USB Port

Recommend to use the cables officially recognized by USB IF.

7.3. I/O Port

7.3.1. I/O Connector Pin Definition

7.3.1.1. MER2/ME2P Series

MER2/ME2P Series I/O port is implemented by Hirose 8-pin receptacle (No. HR25-7TR-8PA(73)), and the corresponding plug is HR25-7TP-8S.

Diagram	Pin	Definition	Description
	1	Line0+	Opto-isolated input +
	2	GND	GPIO GND
	3	Line0-	Opto-isolated input -
	4	POWER_IN	Camera external power +12VDC(-10%)~+24VDC(+10%)
	5	Line2	GPIO input/output
	6	Line3	GPIO input/output
	7	Line1-	Opto-isolated output -
	8	Line1+	Opto-isolated output +

Table 7-3 I/O port definition (back sight of the camera)

1) The polarity of GPIO pins and power cannot be reversed, otherwise, camera or other peripherals could burn out.
2) Only some models support external power supply (see section 4 for details), for models that do not support external power supply, Pin4 is NC.

7.3.1.2. MER2-6P Series

I/O port is implemented by 6-pin Hirose connector (No. HR10A-7R-6PB(73)), and the corresponding plug is HR10A-7P-6S(73).

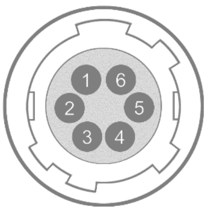
Diagram	Pin	Definition	Description
	1	NC	NC
	2	Line0+	Opto-isolated input+
	3	Line2	GPIO input/output
	4	Line1+	Opto-isolated output+
	5	Line0/1-	Line0-: Opto-isolated input-, Line1-: Opto-isolated output-
	6	GND	PWR GND & GPIO GND

Table 7-4 Pin definition of 6-pin connector (back sight of camera)

The polarity of power cannot be reversed, otherwise, camera or other peripherals could burn out.

7.3.1.3. ME2L Series

ME2L Series I/O port is implemented by Hirose 8-pin receptacle.

Diagram	Pin	Definition	Description
	1	Line0+	Opto-isolated input +
	2	GND	GPIO GND
	3	Line0-	Opto-isolated input -
	4	NC	NC
	5	Line2	GPIO input/output
	6	NC	NC
	7	NC	NC
	8	NC	NC

Table 7-5 I/O port definition (back sight of the camera)

⚠ The polarity of GPIO pins cannot be reversed, otherwise, camera or other peripherals could burn out.

7.3.1.4. ME2S Series

ME2S Series I/O port is implemented by 6-pin Hirose connector (No. HR10A-7R-6PB(73)), and the corresponding plug is HR10A-7P-6S(73).

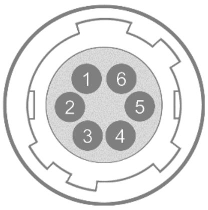
Diagram	Pin	Definition	Description
	1	POWER_IN	Camera external power, +12VDC(-10%)~+24VDC(+10%)
	2	Line0+	Opto-isolated input+
	3	Line2	GPIO input/output
	4	Line1+	Opto-isolated output+
	5	Line0/1-	Line0-: Opto-isolated input -; Line1-:Opto-isolated output -
	6	GND	PWR GND & GPIO GND

Table 7-6 I/O port definition (back sight of camera)

⚠ The polarity of power cannot be reversed, otherwise, camera or other peripherals could burn out.

7.3.2. I/O Electrical Features

The MER2/MER2-6P/ME2P/ME2L/ME2S cameras have different available I/O (MER2/ME2P/ME2L: 8-pin connector, MER2-6P/ME2S: 6-pin connector), see details in 7.3.1.I/O Connector Pin Definition. I/O with the same signal definition are also have the same electrical features.

7.3.2.1. Line0 (Opto-isolated Input) Circuit

Hardware schematics of opto-isolated input circuit is shown as Figure 7-1.

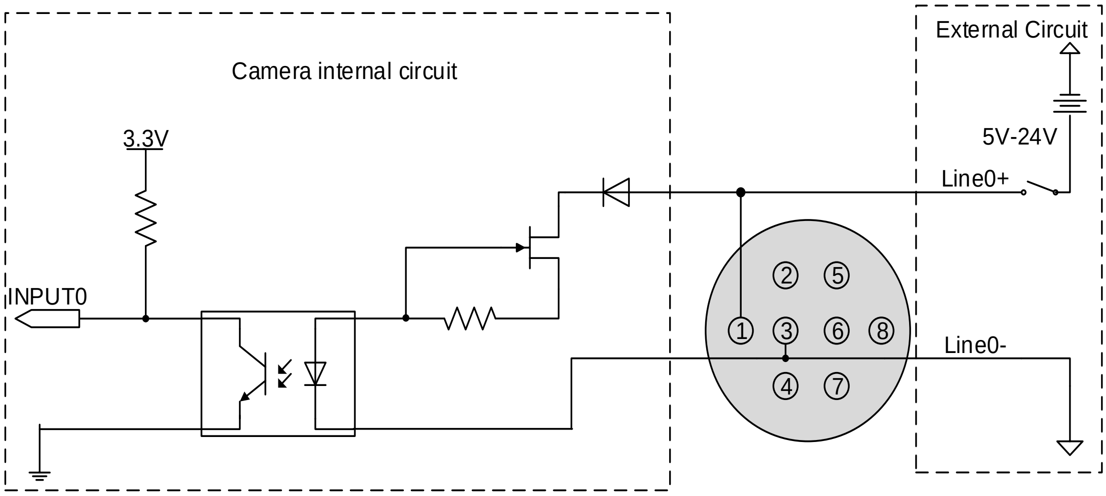


Figure 7-1 Opto-isolated input circuit (MER2/ME2P/ME2L)

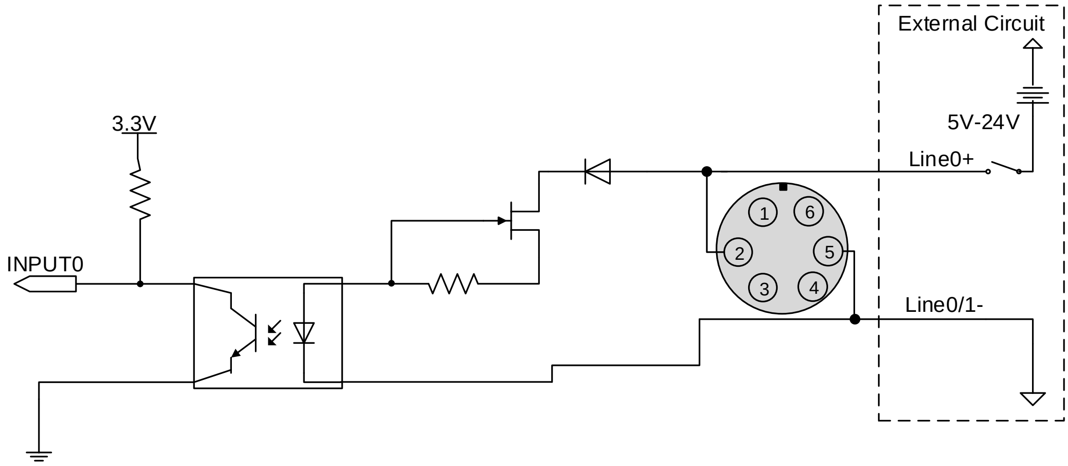


Figure 7-2 Opto-isolated input circuit (MER2-6P/ME2S)

- Logic 0 input voltage: 0V~+2.5V (Line0+ voltage)
- Logic 1 input voltage: +5V~+24V (Line0+ voltage)
- Minimum input current: 7mA
- The status is unstable when input voltage is between 2.5V and 5V, which should be avoided
- When the external input voltage is 5V, there is no need for circuit-limiting resistance in the external input. But if there is a series resistance, please ensure the value is less than 90Ω. In order to protect the Line0+ while the external input voltage is higher than 9V, a circuit-limiting resistance is needed in the external input. The recommended values are shown in Table 7-7

External input voltage	Circuit-limiting resistance (Rlimit)	Line0+ input voltage
5V	Non or <90Ω	About 5V
9V	680Ω	About 5.5V

12V	1kΩ	About 6V
24V	2kΩ	About 10V

Table 7-7 Circuit-limiting resistor value

The connection method of the opto-isolated input circuit and the NPN and PNP photosensor is shown below. The relationship between the pull-up resistor and the external power supply voltage is shown in Table 7-7.

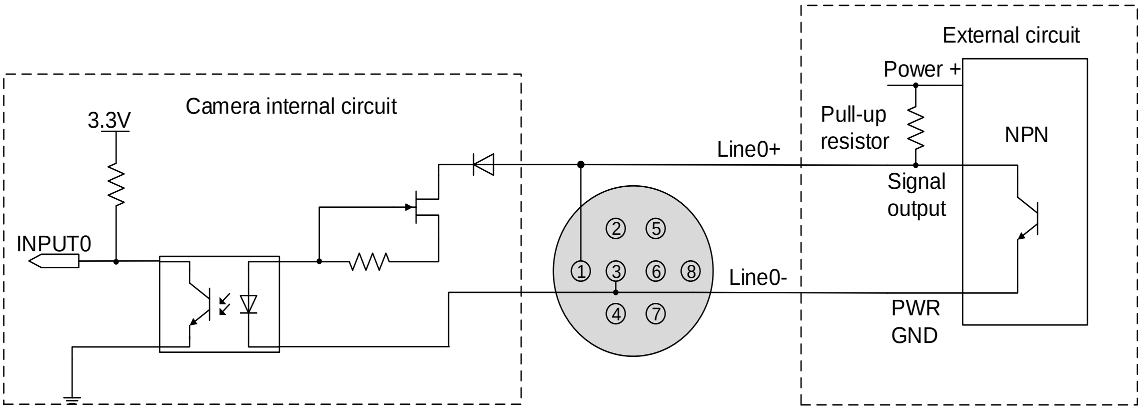


Figure 7-3 NPN photosensor connected to opto-isolated input circuit (MER2/ME2P/ME2L)

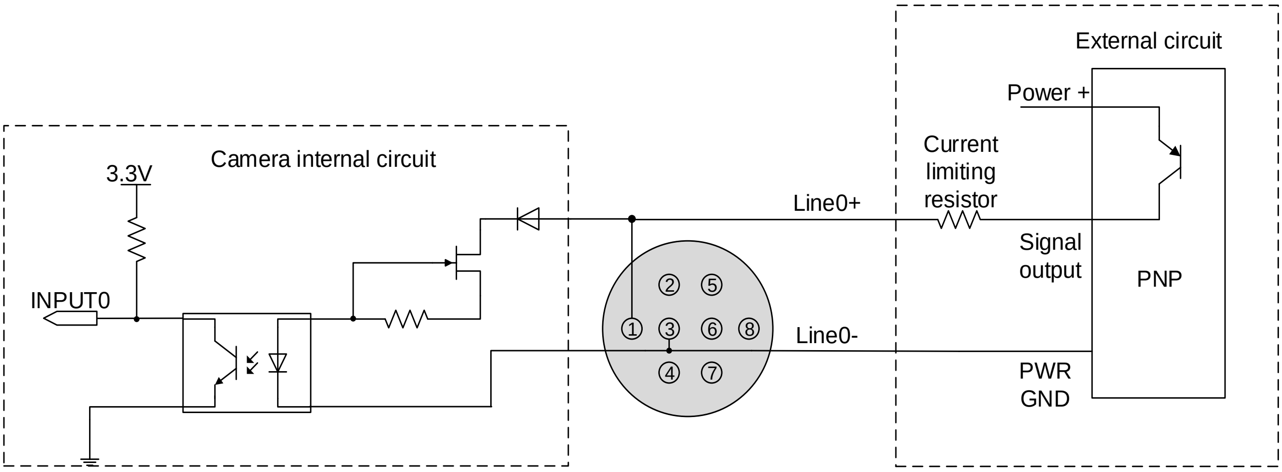


Figure 7-4 PNP photosensor connected to opto-isolated input circuit (MER2/ME2P/ME2L)

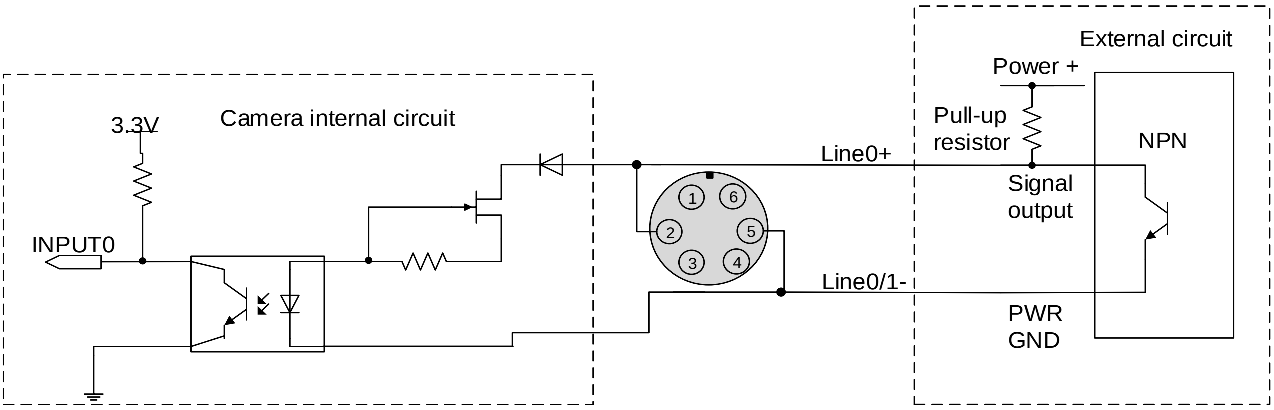


Figure 7-5 NPN photosensor connected to opto-isolated input circuit (MER2-6P/ME2S)

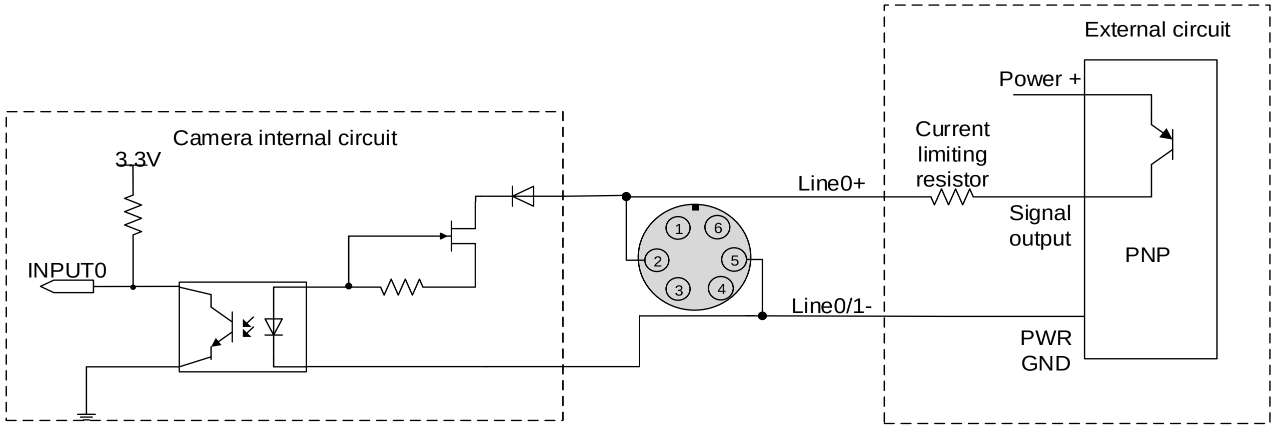


Figure 7-6 PNP photosensor connected to opto-isolated input circuit (MER2-6P/ME2S)

- Rising edge delay: <50μs (0°C~45°C), parameter description as shown in Figure 7-7
- Falling edge delay: <50μs (0°C~45°C), parameter description as shown in Figure 7-7
- Different environment temperature and input voltage have influence on delay time of opto-isolated input circuit. Delay times in typical application environment (temperature is 25°C) is as shown in Table 7-8

Parameter	Test condition	Value (μs)		
Rising edge delay	VIN=5V	3.02	~	6.96
	VIN=12V	2.46	~	5.14
Falling edge delay	VIN=5V	6.12	~	17.71
	VIN=12V	8.93	~	19.73

Table 7-8 Delay time of opto-isolated input circuit in typical application environment

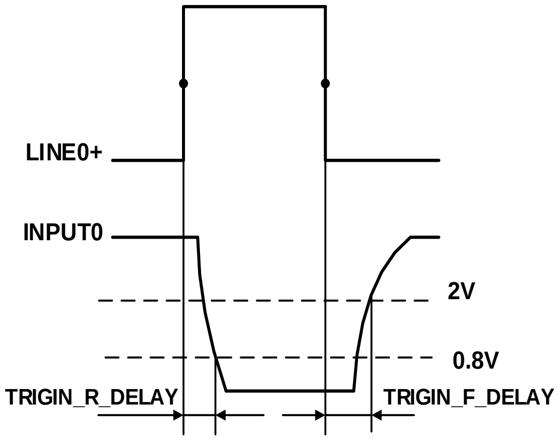


Figure 7-7 Parameter of opto-isolated input circuit

- Rising time delay (TRIGIN_R_DELAY): the time required for the response to the decrease to 0.8V of INPUT0 from 50% rising of LINE0+
- Falling time delay (TRIGIN_F_DELAY): the time required for the response to the rise to 2V of INPUT0 from 50% falling of LINE0+

7.3.2.2. Line1 (Opto-isolated Output) Circuit

Hardware schematics of opto-isolated output circuit is shown below.

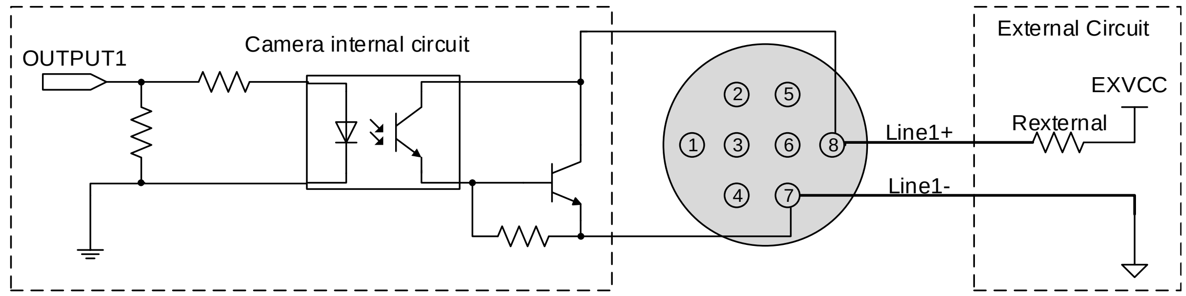


Figure 7-8 Opto-isolated output circuit (MER2/ME2P/ME2L)

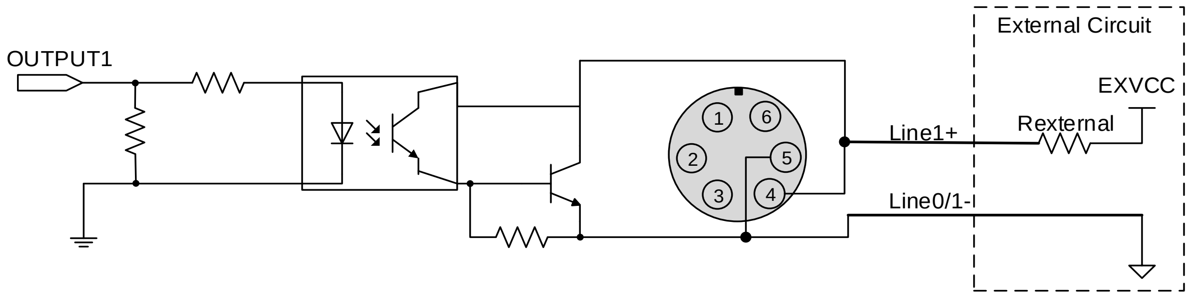


Figure 7-9 Opto-isolated output circuit (MER2-6P/ME2S)

- Range of external voltage (EXVCC) is 5~24V
- Maximum output current of Line1 is 25mA
- Transistor voltage drop and output current of opto-isolated output circuit in typical application environment (temperature is 25°C) is as shown in Table 7-9

External voltage EXVCC	External resistance Rexternal	Transistor voltage drop (turn on, unit V)	Output current (mA)
5V	1kΩ	0.90	4.16
12V	1kΩ	0.97	11.11
24V	1kΩ	1.04	23.08

Table 7-9 Transistor voltage drop and output current of opto-isolated output circuit in typical application environment

- Rising time delay = td+tf: <50μs (0°C~45°C) (parameter description is shown in Figure 7-10)
- Falling time delay = ts+tr: <50μs (0°C~45°C) (parameter description is shown in Figure 7-10)
- Delay parameters are affected greatly by external voltage, external pull-up resistor and temperature. Delay time in typical application conditions (environment temperature is 25°C) are shown in Table 7-10

Parameter	Test Condition	Value (μs)		
Storage time (ts)	External power is 5V, pull-up resistor is 1kΩ	6.16	~	13.26
Delay time (td)		1.90	~	3.16
Rising time (tr)		2.77	~	10.60
Falling time (tf)		7.60	~	11.12
Rising time delay = td+tf		4.70	~	13.76
Falling time delay = ts+tr		14.41	~	24.38
Storage time (ts)	External power is 24V, pull-up resistor is 4.7kΩ	9.81	~	14.50
Delay time (td)		2.29	~	4.09
Rising time (tr)		7.29	~	25.30
Falling time (tf)		23.76	~	25.16
Rising time delay = td+tf		9.58	~	29.39
Falling time delay = ts+tr		34.39	~	39.59

Table 7-10 Delay time of opto-isolated output circuit in typical application environment

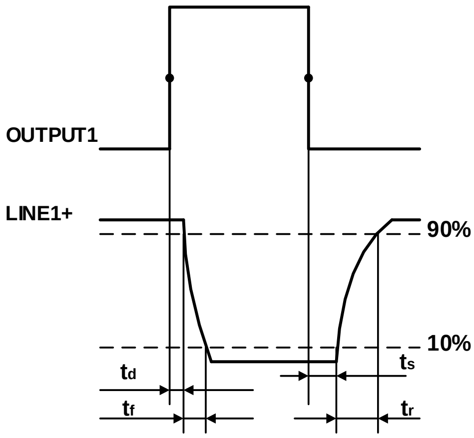


Figure 7-10 Parameter of opto-isolated output circuit

- Delay time (td): the time required from 50% rising of OUTPUT1 to the decrease to 90% of the maximum value of LINE1+
- Falling time (tf): the time taken for the amplitude of LINE1+ to decrease from 90% to 10% of the maximum value
- Storage time (ts): the time required from 50% falling of OUTPUT1 to the rise to 10% of the maximum value of LINE1+
- Rising time (tr): the time for the response of LINE1+ to rise from 10% to 90% of its final value

7.3.2.3. GPIO 2/3 (Bidirectional) Circuit

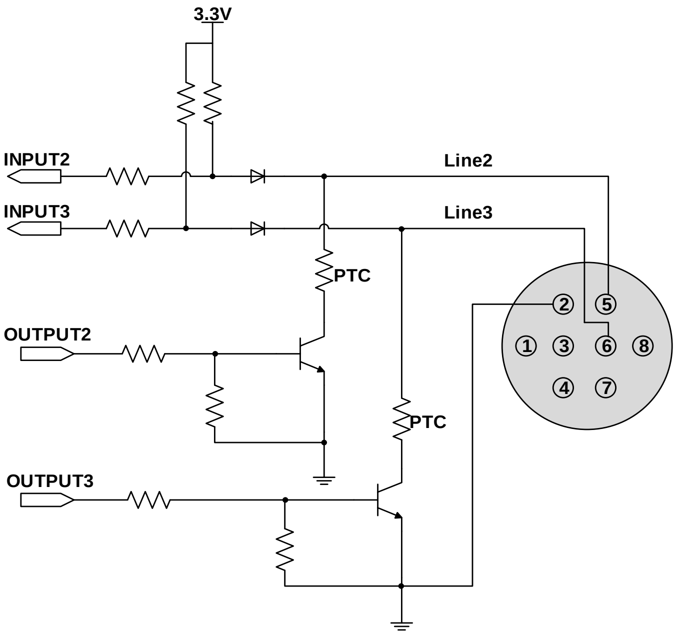


Figure 7-11 Line2/3 (bidirectional) circuit (MER2/ME2P)

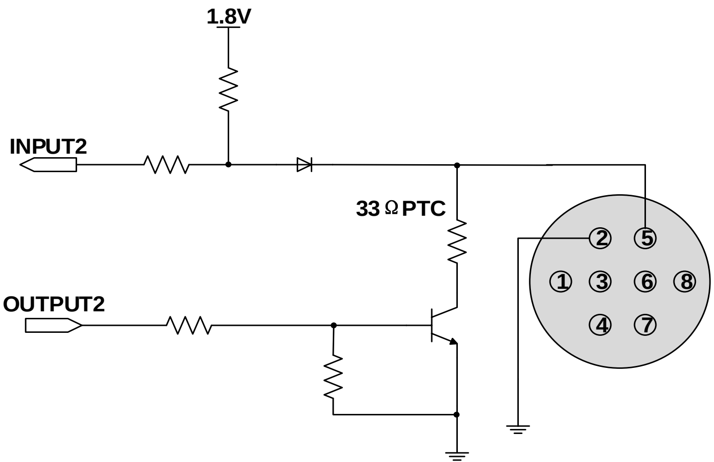


Figure 7-12 Line2 (bidirectional) circuit (ME2L)

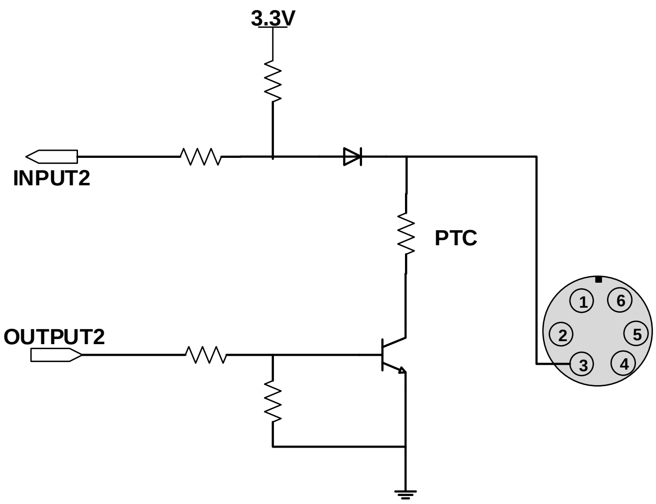


Figure 7-13 Line2 (bidirectional) circuit (MER2-6P/ME2S)

7.3.2.3.1. Line2/3 is Configured as Input

- When Line2/3 is configured as input, the internal equivalent circuit of camera is shown below, taking Line2 as an example

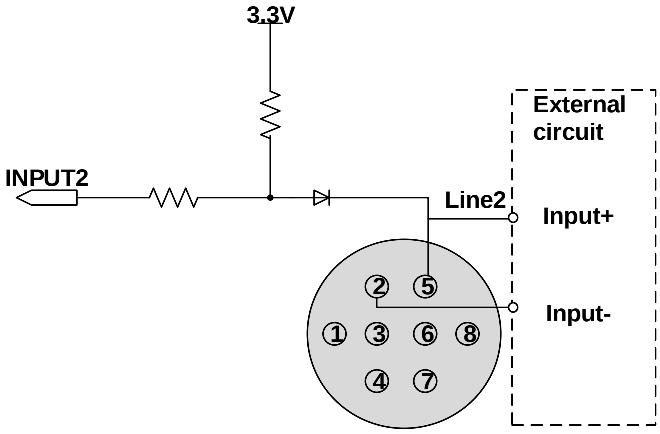


Figure 7-14 Internal equivalent circuit of camera when Line2 is configured as input (MER2/ME2P)

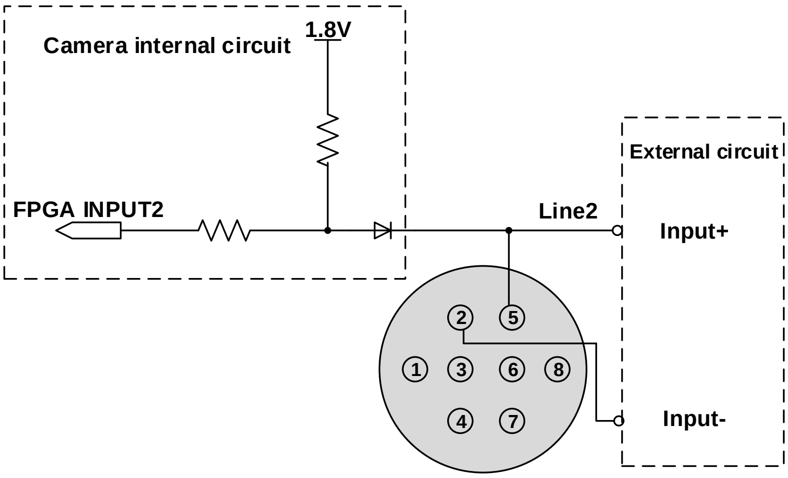


Figure 7-15 Internal equivalent circuit of camera when Line2 is configured as input (ME2L)

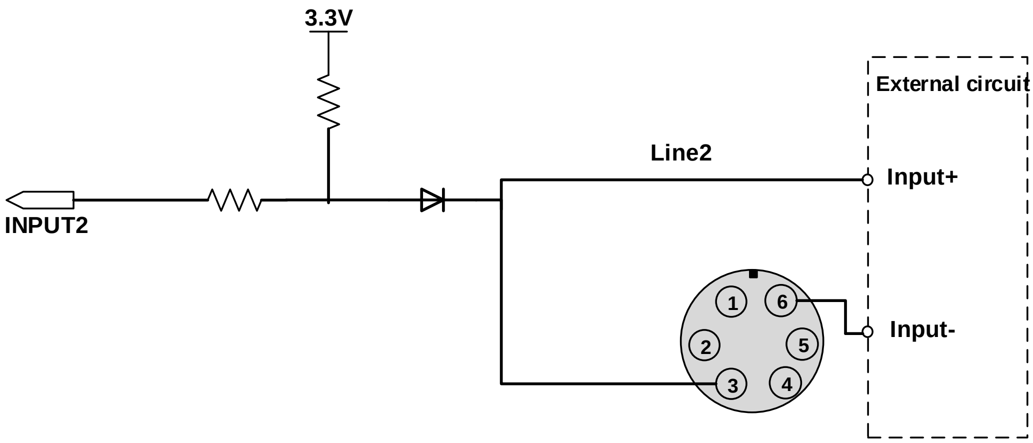


Figure 7-16 Internal equivalent circuit of camera when Line2 is configured as input (MER2-6P/ME2S)

To avoid the damage of GPIO pins, please connect GND pin before supplying power to Line2/3.

- Logic 0 input voltage: 0V~+0.6V(Line2/3 voltage)
- Logic 1 input voltage: +1.9V~+24V(Line2/3 voltage)
- The status is unstable when input voltage is between 0.6V and 1.9V, which should be avoided
- When input of Line2/3 is high, input current is lower than 100μA. When input of Line2/3 is low, input current is lower than -1mA
- When Line2/3 is configured as input. The connection method between them and NPN and PNP photoelectric sensors is shown below.

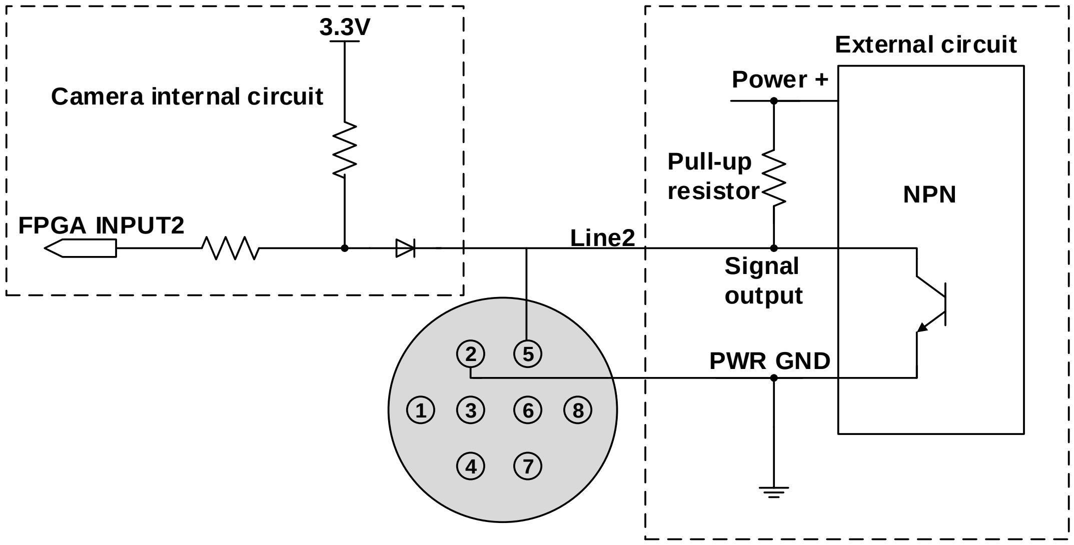


Figure 7-17 NPN photoelectric sensor connected to Line2 input circuit (MER2/ME2P)

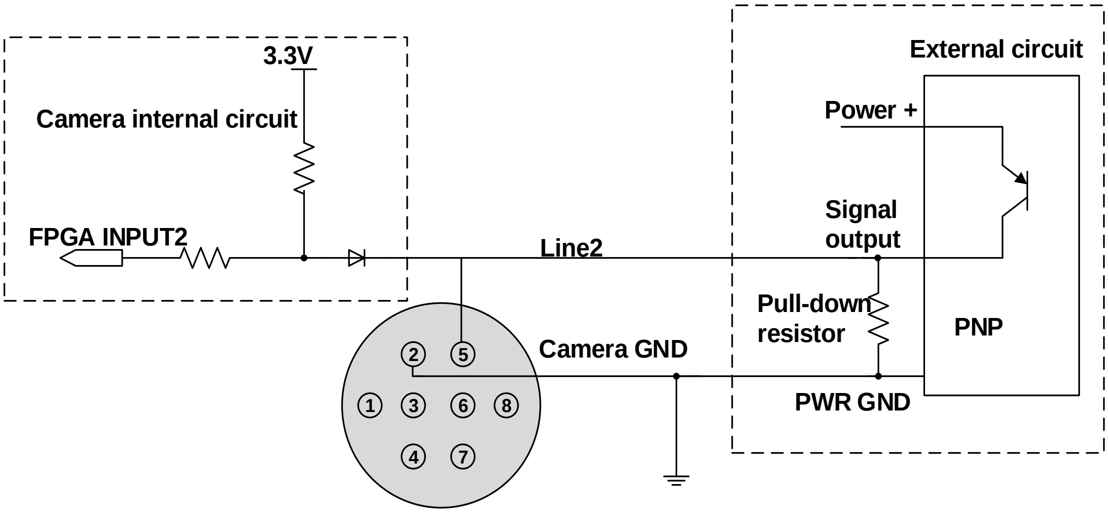


Figure 7-18 PNP photoelectric sensor connected to Line2 input circuit (MER2/ME2P)

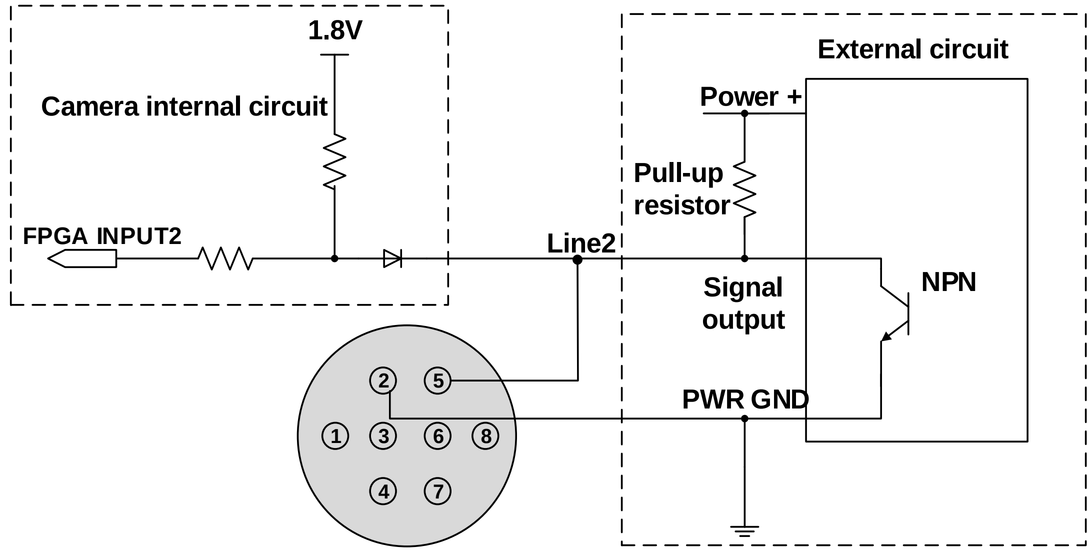


Figure 7-19 NPN photoelectric sensor connected to Line2 input circuit (ME2L)

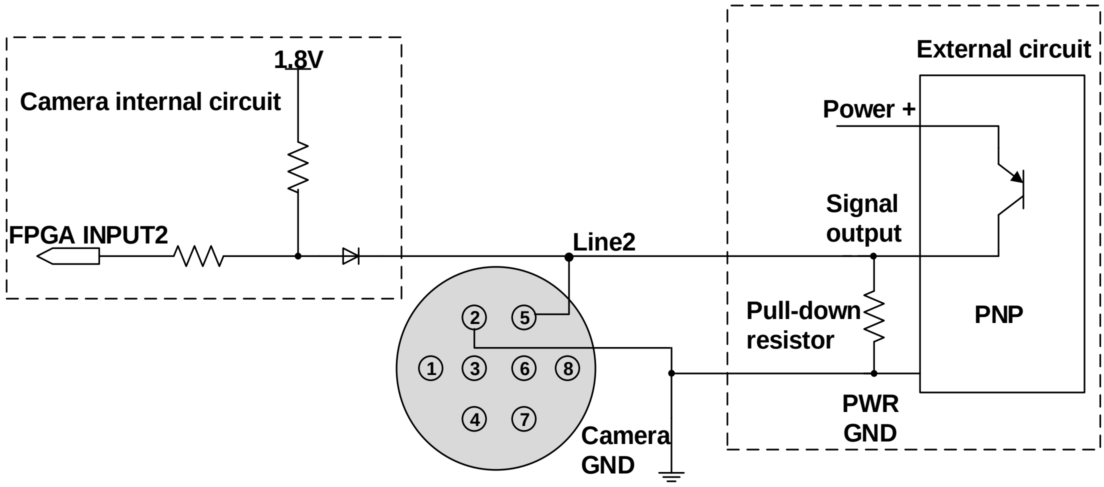


Figure 7-20 PNP photoelectric sensor connected to Line2 input circuit (ME2L)

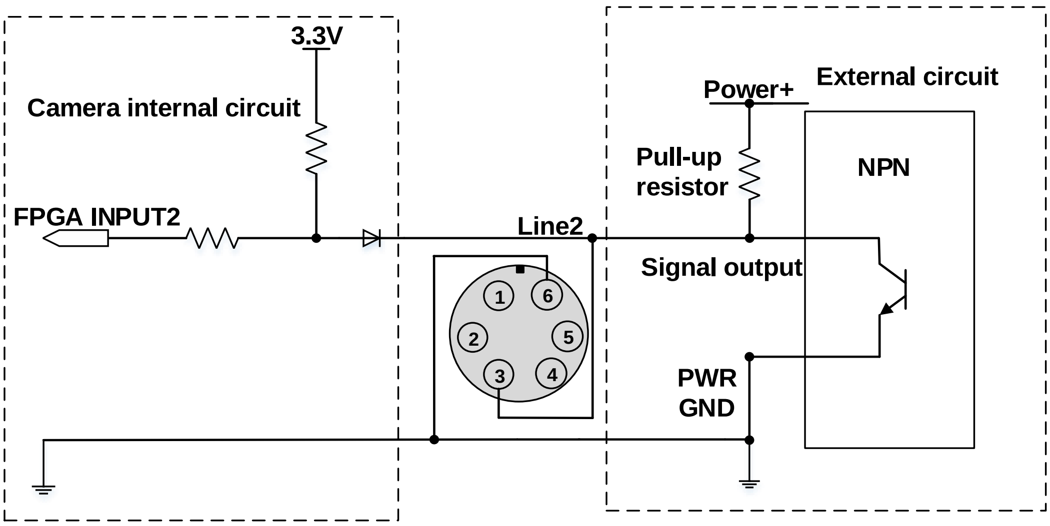


Figure 7-21 NPN photoelectric sensor connected to Line2 input circuit (MER2-6P/ME2S)

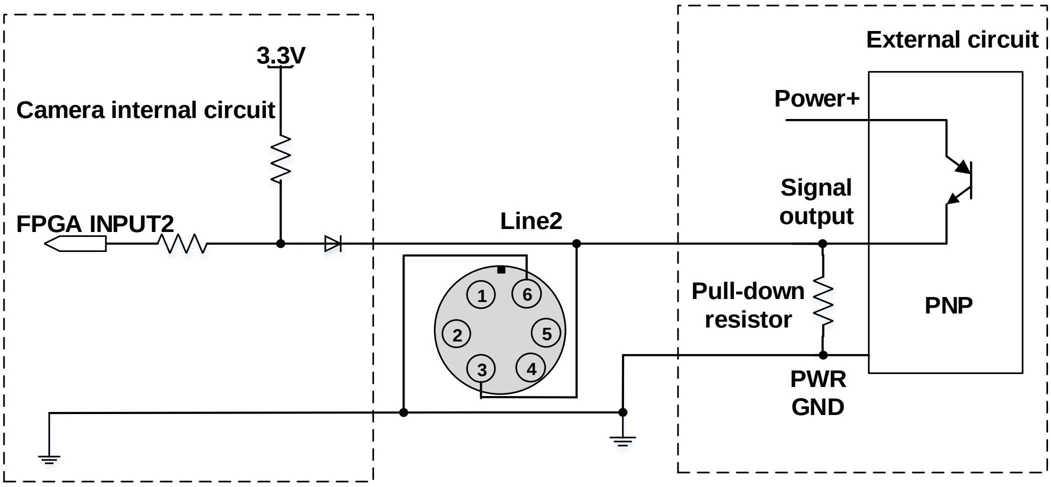


Figure 7-22 PNP photoelectric sensor connected to Line2 input circuit (MER2-6P/ME2S)

- When LIine2/3 is configured as input, pull-down resistor over 1K should not be used, otherwise the input voltage of Line2/3 will be over 0.6V and logic 0 cannot be recognized stably
- Input rising time delay: <2μs (0°C~45°C), parameter description as shown in Figure 7-23
- Input falling time delay: <2μs (0°C~45°C), parameter description as shown in Figure 7-23

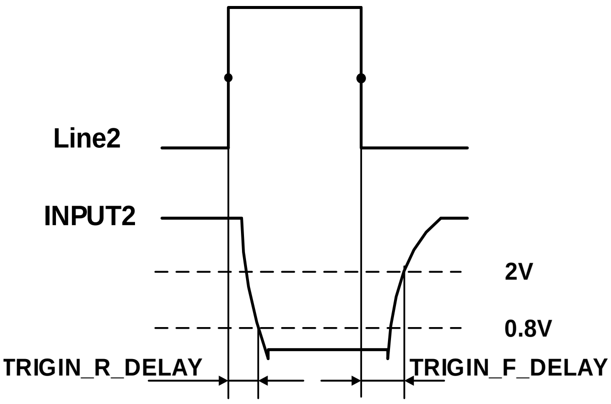


Figure 7-23 Parameter of Line2 input circuit

7.3.2.3.2. Line2/3 is Configured as Output

- Range of external voltage (EXVCC) is 5~24V
- Maximum output current of Line2/3 is 25mA, output impedance is 40Ω
- Transistor voltage drop and output current in typical application conditions (temperature is 25°C) are shown in Table 7-11

External voltage EXVCC	External resistance Rexternal	Transistor voltage drop (turn on, unit V)	Output current (mA)
5V	1kΩ	0.19	4.8
12V		0.46	11.6
24V		0.92	23.1

Table 7-11 Transistor voltage drop and output current of Line2/3 in typical conditions

- Rising time delay = td+tf: <20μs (0°C~45°C) (parameter description as shown in Figure 7-24)
- Falling time delay = ts+tr: <20μs (0°C~45°C) (parameter description as shown in Figure 7-24)
- Delay parameters are affected greatly by external voltage and external pull-up resistor, but little by temperature. Output delay time in typical application conditions (temperature is 25°C) are shown in Table 7-12

Parameter	Test Conditions	Value (μs)		
Storage time (ts)	External power is 5V, pull-up resistor is 1kΩ	0.17	~	0.18
Delay time (td)		0.08	~	0.09
Rising time (tr)		0.11	~	0.16
Falling time (tf)		1.82	~	1.94
Rising time delay = td+tf		0.19	~	0.26
Falling time delay = ts+tr		1.97	~	2.09
Storage time (ts)	External power is 24V, pull-up resistor is 4.7kΩ	0.52	~	0.61
Delay time (td)		0.09	~	0.11
Rising time (tr)		0.20	~	0.28
Falling time (tf)		9.56	~	10.06
Rising time delay = td+tf		0.28	~	0.37
Falling time delay = ts+tr		10.15	~	10.57

Table 7-12 Delay time when GPIO is configured as output in typical conditions

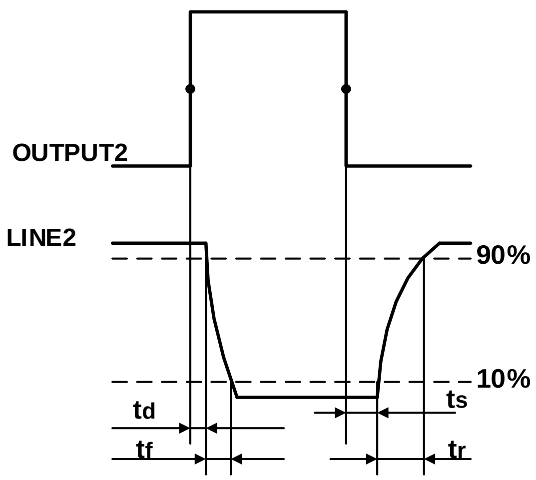


Figure 7-24 Parameter of Line2 output circuit

- Delay time (td): the time required from 50% rising of OUTPUT2 to the decrease to 90% of the maximum value of LINE2

- Falling time (tf): the time taken for the amplitude of LINE2 to decrease from 90% to 10% of the maximum value
- Storage time (ts): the time required from 50% falling of OUTPUT2 to the rise to 10% of the maximum value of LINE2
- Rising time (tr): the time for the response of LINE2 to rise from 10% to 90% of its final value
- When Line2/3 is configured as output, the internal equivalent circuit of camera is shown below, taking Line2 as an example

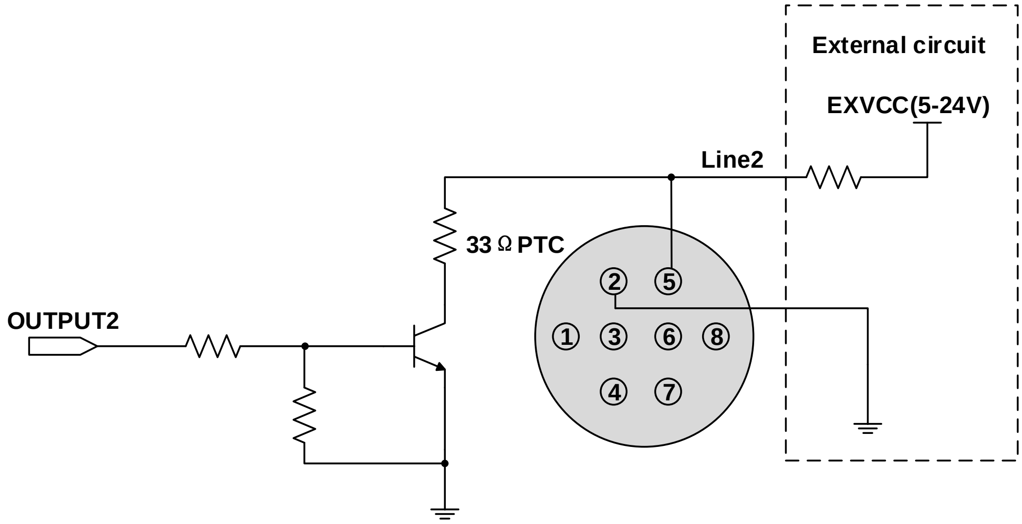


Figure 7-25 Internal equivalent circuit of camera when Line2 is configured as output (MER2/ME2P/ME2L)

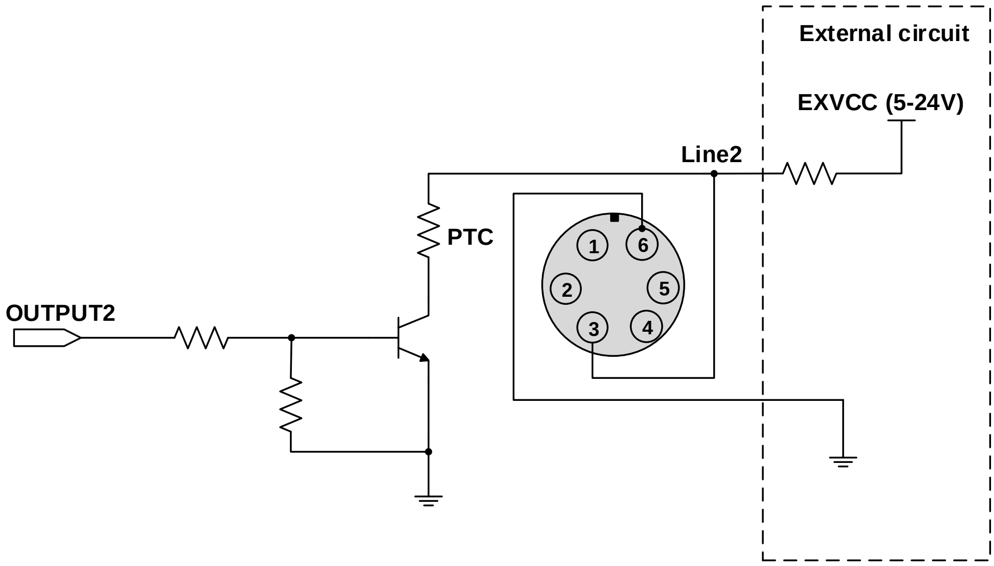


Figure 7-26 Internal equivalent circuit of camera when Line2 is configured as output (MER2-6P/ME2S)

8. Features

MERCURY2 USB3 Vision camera supports a variety of standard and advanced functions. The function support of different models varies slightly. Please refer to the DAHENG Cameras Feature List for details.

8.1. I/O Control

The MER2/MER2-6P/ME2P/ME2L/ME2S cameras have different available I/O (MER2/ME2P/ME2L: 8-pin connector, MER2-6P/ME2S: 6-pin connector), see details in 7.3.1 I/O Connector Pin Definition. I/O with the same signal definition are also have the same features.

8.1.1. Input Mode Operation

1) Configuring Line as input

The camera's Line0 is uni-directional opto-isolated input, Line2 and Line3 are bi-directional lines which can be configured as input or output.

The camera's default input is Line0 when the camera is powered on. Line2 and Line3 are input by default, which can be configured to be input or output by LineMode.

2) Input Debouncer

In order to suppress the interference signals from hardware trigger, the camera has the hardware trigger filtering feature, including rising edge filtering and falling edge filtering. The user can set the trigger filter feature by setting the "TriggerFilterRaisingEdge" and the "TriggerFilterFallingEdge". The range of the trigger filter feature is [0, 5000] μs, step: 1μs.

Example 1: Setting the rising edge filter width to 1ms, the pulse width less than 1ms in the rising edge will be filtered out, as shown in Figure 8-1:

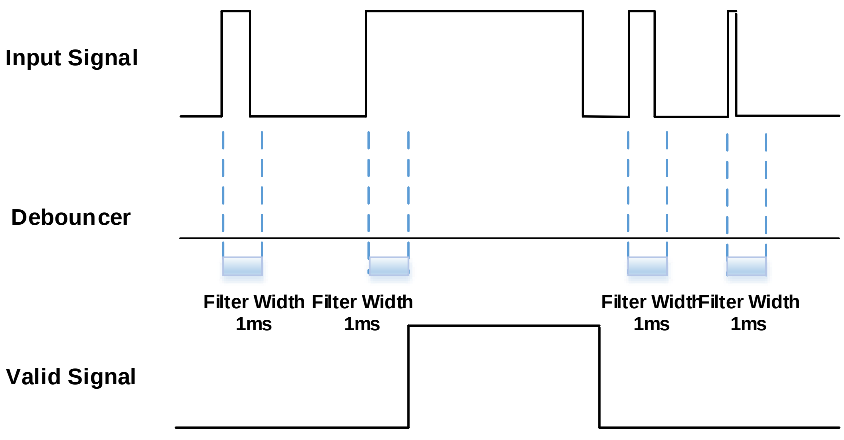


Figure 8-1 Input debouncer schematic diagram

3) Trigger Delay

The camera has trigger delay feature. The user can set the trigger delay feature by setting "TriggerDelay". The range of the trigger delay feature is [0, 3000000] μs, step: 1μs.

Example 1: Setting the trigger delay value to 1000ms, and the trigger signal will be valid after 1000ms delay, as shown in Figure 8-2.

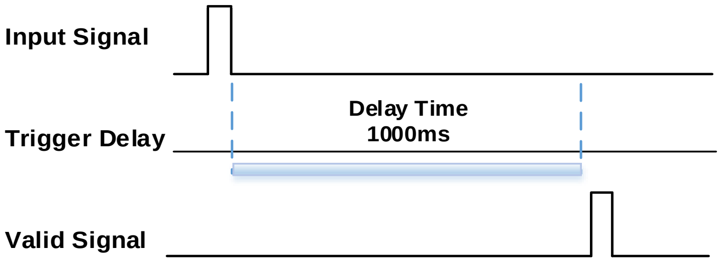


Figure 8-2 Trigger delay schematic diagram

4) Input Inverter

The signal level of input lines is configurable for the camera. The user can select whether the input level is reverse or not by setting "LineInverter".

The default input line level is false when the camera is powered on, indicating that the input line level is not reversed. If it is set as true, indicating that the input line level is reversed. As shown in the Figure 8-3:

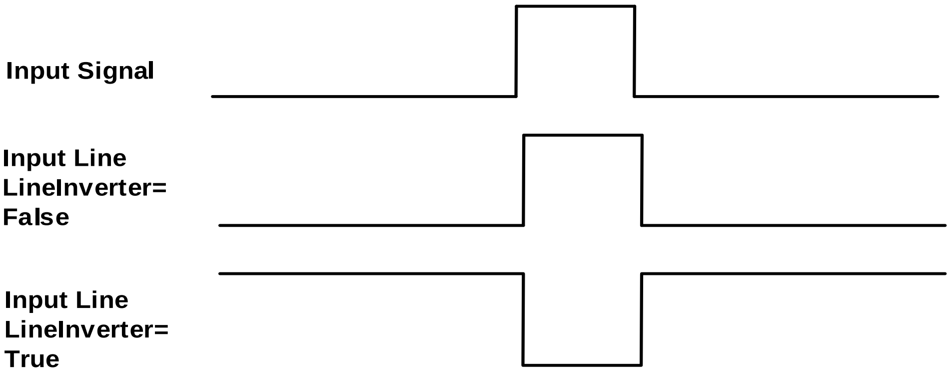


Figure 8-3 Setting input line to reverse

8.1.2. Output Mode Operation

1) Configuring Line as output

The camera's Line1 is a uni-directional opto-isolated output I/O, Line2 and Line3 are bi-direction configurable I/Os.

The Line1 is camera's default (Line2 is the default if the camera does not support Line1) output when the camera is powered on. Line2 and Line3 can be configured to be output by changing the "LineMode" of this line.

Each output source of the three output lines is configurable, and the output source includes: Strobe, UserOutput0, UserOutput1, UserOutput2, ExposureActive, FrameTriggerWait, AcquisitionTriggerWait, Timer1Active. And ExposureActive, FrameTriggerWait, AcquisitionTriggerWait and Timer1Active are supported by partial models only.

The default output source of the camera is UserOutput0 when the camera is powered on.

What status (high or low level) of the output signal is valid depends on the specific external circuit. The following signal diagrams are described as examples of active low.

- Strobe

In this mode the camera sends a trigger signal to activate the strobe. The strobe signal is active low. After receiving the trigger signal, the strobe signal level is pulled low. In global shutter mode and global reset release shutter mode, the strobe signal low level lasting time is the sum of the exposure delay time and the exposure time. In electronic rolling shutter mode, the strobe signal low level lasting time is the common exposure time for all lines, and the strobe signal outputs only when the "exposure time > (image height - 1) * row period". There is no strobe signal outputs when there is no common exposure time for all lines.

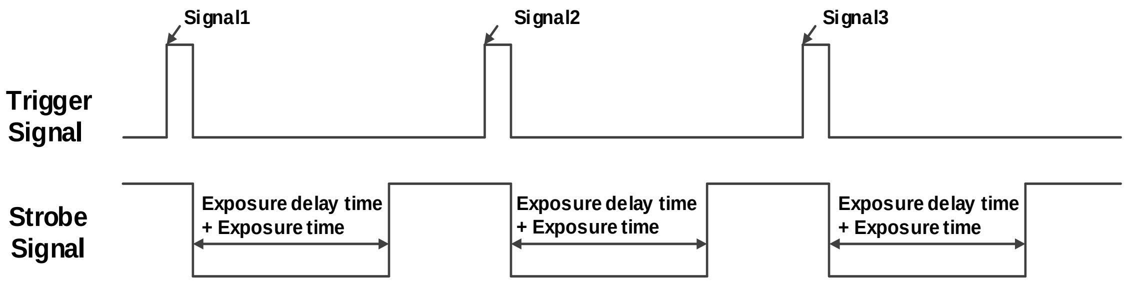


Figure 8-4 Strobe signal schematic diagram (global shutter and global reset release shutter)

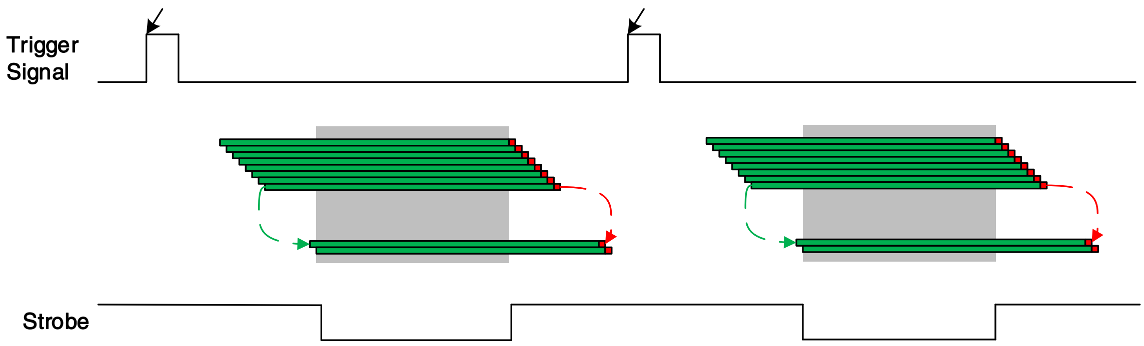


Figure 8-5 Strobe signal schematic diagram (all lines have common exposure time in electronic rolling shutter)

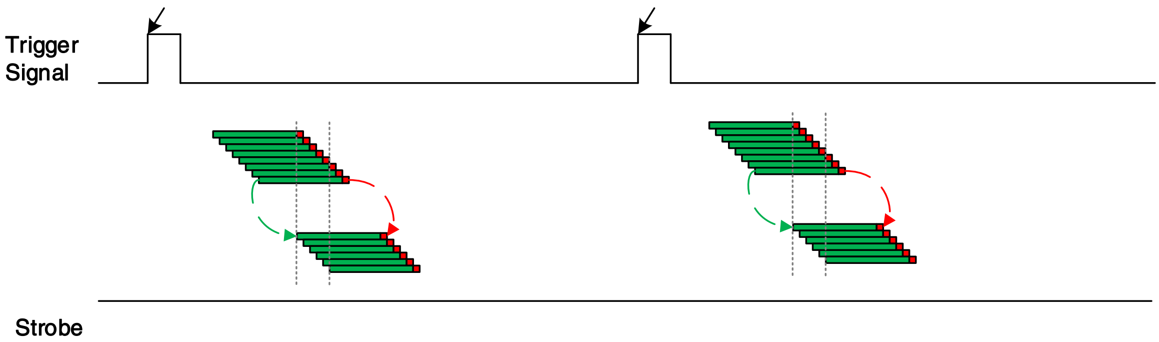


Figure 8-6 Strobe signal schematic diagram (all lines have no common exposure time in electronic rolling shutter)

- UserOutput

In this mode, the user can set the camera's constant output level for special processing, such as controlling the constant light source or the alarm light (two level types are available: high level or low level).

For example: select line2 as the output line, the output source is selected as UserOutput1, and the output value is defined as true.

"LineSelector" is selected as "line2", "LineMode" is set to "Output", "LineSource" is set to "UserOutput1", "UserOutputSelector" is selected as "UserOutput1", and "UserOutputValue" is set to "true".

- ExposureActive

You can use the "ExposureActive" signal to check whether the camera is currently exposing. The signal goes low at the beginning of the exposure and the signal goes high at the end of the exposure. In electronic rolling shutter and global reset release shutter modes, the signal goes high when the exposure of the last line ends.

The electronic rolling shutter mode supports overlapped exposure and is in overlapping exposure mode when the "frame period - exposure time ≤ readout time", at which time the "ExposureActive" signal is always low.

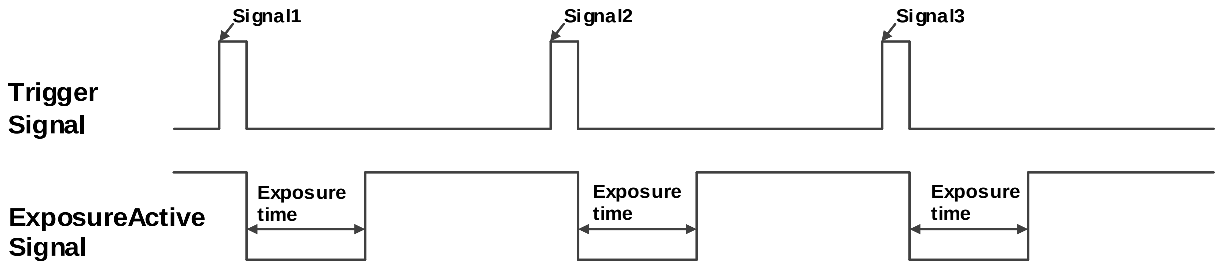


Figure 8-7 Global shutter mode "ExposureActive" signal schematic diagram

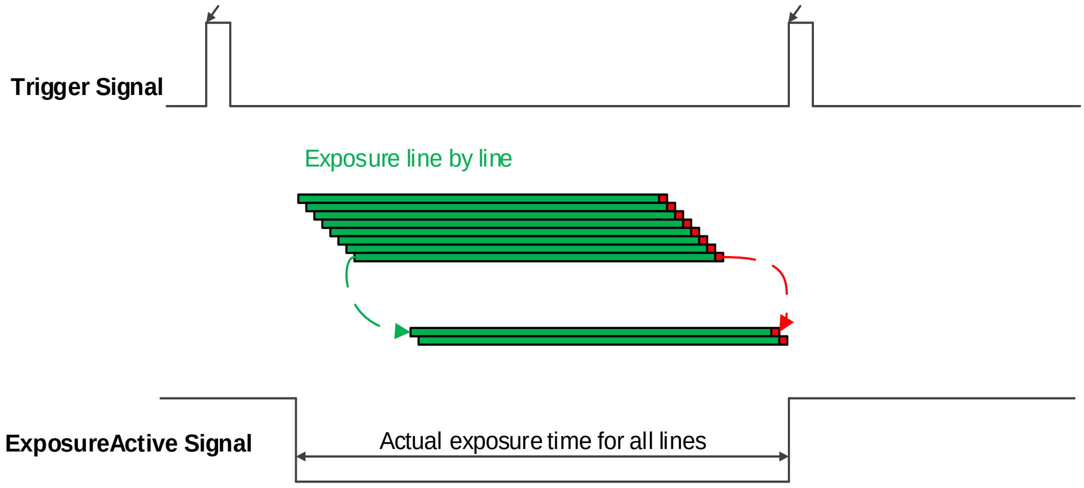


Figure 8-8 Electronic rolling shutter mode (non-overlapping exposure) "ExposureActive" signal schematic diagram

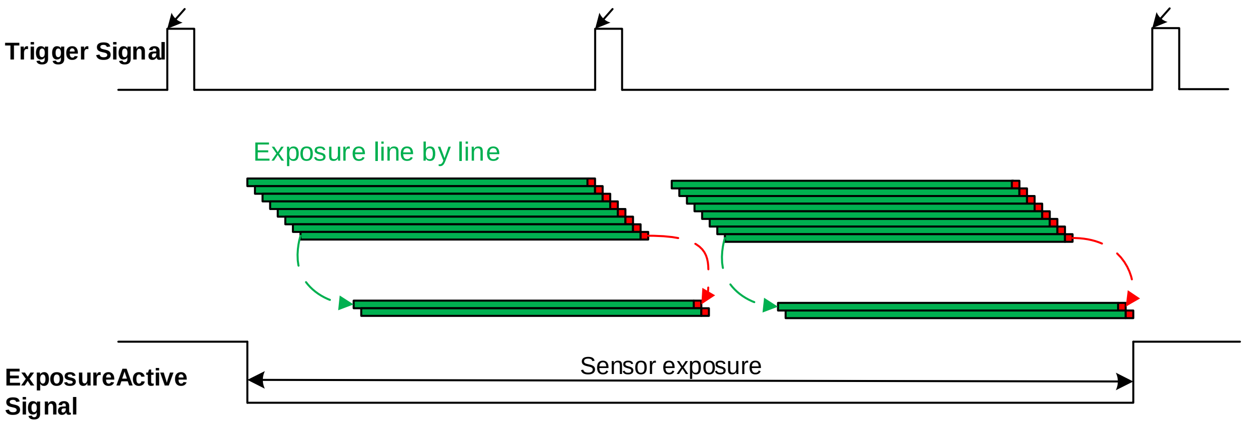


Figure 8-9 Electronic rolling shutter mode (overlapping exposure) "ExposureActive" signal schematic diagram

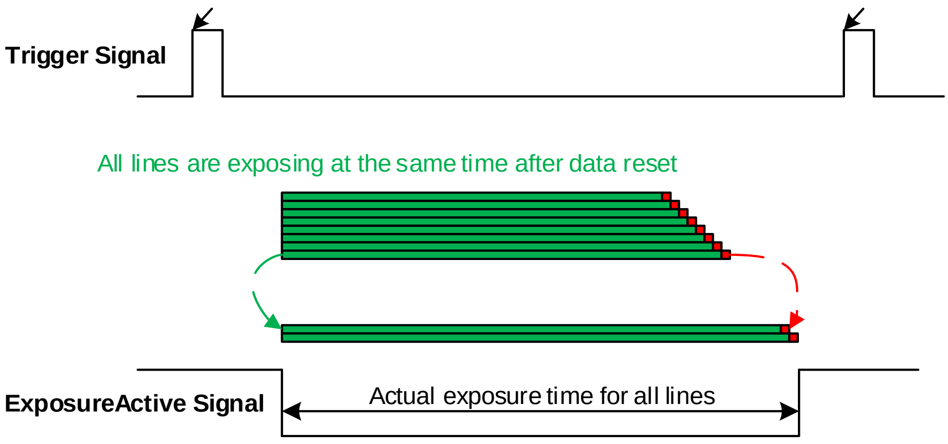


Figure 8-10 Global reset release shutter mode "ExposureActive" signal schematic diagram

This signal is useful when the camera or target object is moving. For example, suppose the camera is mounted on a robotic arm that can move the camera to different position. Generally, it is not desirable for the camera to move during the exposure. In this case, you can check the exposure activity signal to know the exposure time so you can avoid moving the camera during this time.

- TriggerWait

The "TriggerWait" signal can be used to optimize the acquisition of the trigger image and to avoid excessive triggering.

It is recommended to use the "TriggerWait" signal only when the camera is configured for hardware trigger. For software trigger, please use the "AcquisitionStatus". When the camera is ready to receive a trigger signal of the corresponding trigger mode, the "TriggerWait" signal goes low. When the corresponding trigger signal is used, the "TriggerWait" signal goes high. It remains high until the camera is ready to receive the next trigger.

When the trigger mode is "FrameStart" ("FrameBurstStart" mode is off), the camera acquires only one frame of image when it receives the trigger signal. After receiving the trigger signal, the "FrameTriggerWait" signal is pulled low and the camera starts exposure transmission. After the transfer is complete, the "FrameTriggerWait" signal is pulled high.

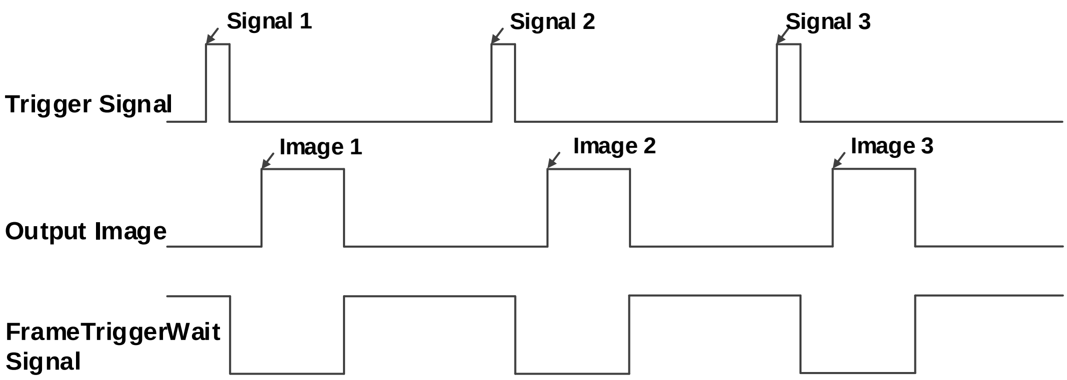


Figure 8-11 "FrameTriggerWait" signal schematic diagram

When the trigger mode is "FrameBurstStart" ("FrameStart" mode is off), each time the camera receives a trigger signal, and it will acquire the set AcquisitionFrameCount frames of image. After receiving the trigger signal, the "AcquisitionTriggerWait" signal is pulled low and the camera starts the exposure transmission. When the transmission is completed and images are transferred, the "AcquisitionTriggerWait" signal will be pulled high.

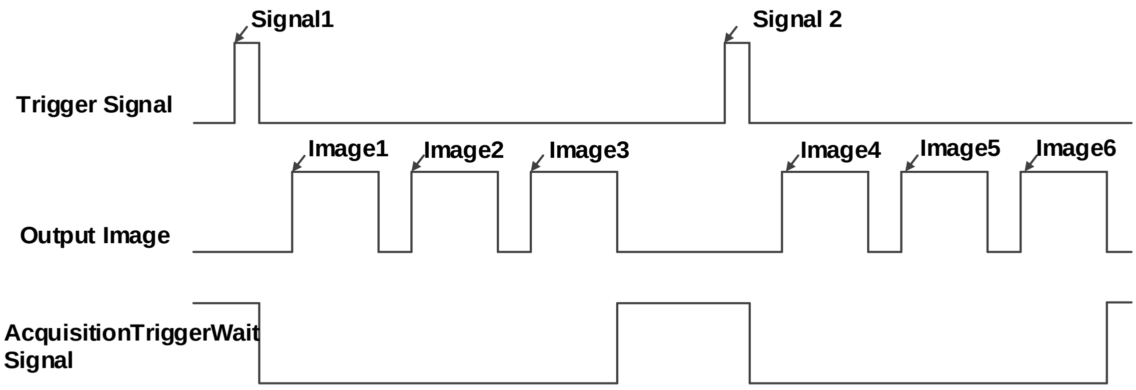


Figure 8-12 "AcquisitionTriggerWait" signal schematic diagram

When the trigger mode is "FrameBurstStart" ("FrameStart" mode is on), if the high-speed burst frames is set to 3, the camera will first send a "FrameBurstStart" trigger signal. After receiving the trigger signal, the "AcquisitionTriggerWait" signal is pulled low. Then three "FrameStart" trigger signals need to be sent continuously. Each time the camera receives a trigger signal, it transmits one frame image. After receiving the trigger signal, the "FrameTriggerWait" signal is pulled low and the camera will start exposure transmission. The "FrameTriggerWait" signal will be pulled high after the transmission is completed. Only the first 3 FrameStart trigger signals are valid. When the transmission is completed, the "AcquisitionTriggerWait" signal will be pulled high.

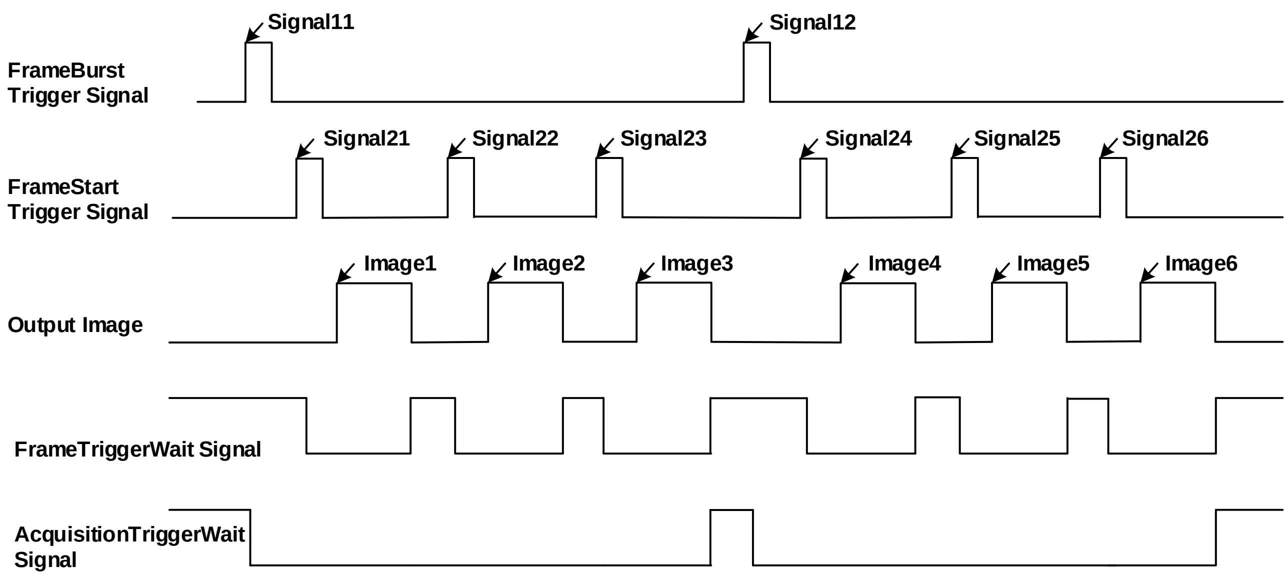


Figure 8-13 "TriggerWait" signal schematic diagram when "FrameBurstStart" and "FrameStart" enabled simultaneously

2) Setting the user-defined status for the output lines

The camera can select the user-defined output by setting "LineSource", by setting "UserOutputValue" to configure the output signal.

By setting "UserOutputSelector" to select UserOutput0, UserOutput1 or UserOutput2.

By setting "UserOutputValue" to set the user-defined output value, and the default value is false when the camera is powered on.

3) Output Inverter

In order to facilitate the camera IO configuration and connection, the camera can configure output signal level. The user can select whether the output level is reverse or not by setting "LineInverter".

The default output signal level is false when the camera is powered on, indicating that the output line level is not reversed. If it is set as true, indicating that the output line level is reversed. As shown in the Figure 8-14.

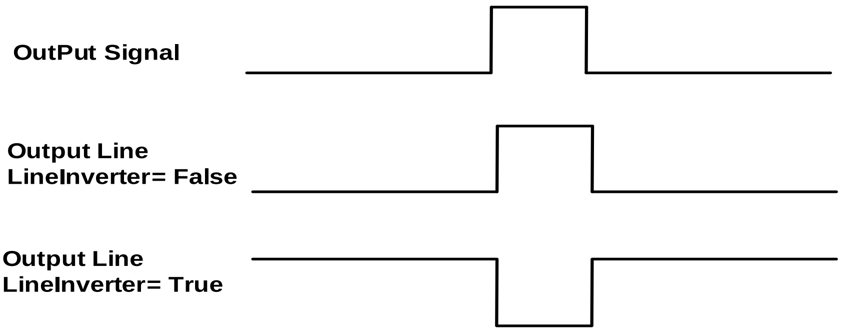


Figure 8-14 Set output line reversion

8.1.3. Read the LineStatus

1) Read the level of single line

The camera can get the line's signal status. When the device is powered on, the default status of Line0 is false, and the default status of Line1, Line2 and Line3 is true.

2) Read all the lines level

The camera can get the current status of all lines. On the one hand, the signal status is the status of the external I/O after the reversal of the polarity. On the other hand, signal status level can reflect the external I/O level.

All the lines level status bit of the camera are shown in Table 8-1. The default polarity does not reverse. The default value of MER2/MER2-6P/ME2P/ME2S cameras is 0xE, and the default value of ME2L cameras is 0x4.

Line3	Line2	Line1	Line0
1	1	0	0

Table 8-1 Camera line status bit

8.2. Image Acquisition Control

8.2.1. Acquisition Start and Stop

8.2.1.1. Acquisition Start

It can send **AcquisitionStart** command immediately after opening the camera. The acquisition process in continuous mode is illustrated in Figure 8-15, and the acquisition process in trigger mode is illustrated in Figure 8-16.

- **Continuous Acquisition**

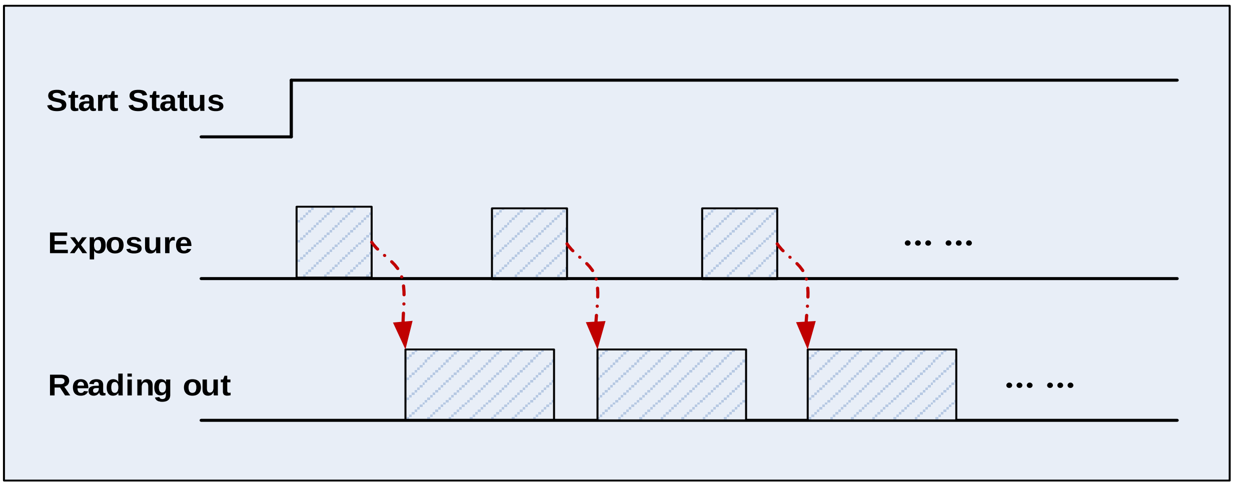


Figure 8-15 Continuous acquisition process

In continuous mode, a camera starts to expose and read out after receiving the **AcquisitionStart** command. The frame rate is determined by the exposure time, ROI and some other parameters.

- **Trigger Acquisition**

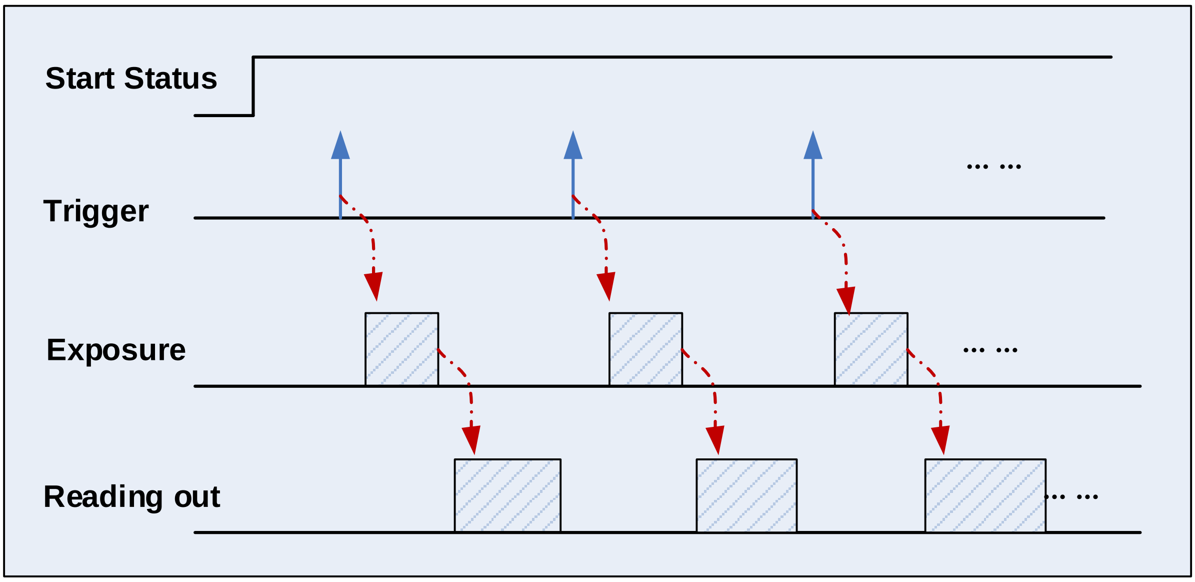


Figure 8-16 Trigger acquisition process

In trigger mode, sending **AcquisitionStart** command is not enough, a trigger signal is also needed. Each time a frame trigger is applied (including software trigger and hardware trigger), the camera will acquire and transmit a frame of image.

8.2.1.2. Acquisition Stop

It can send **AcquisitionStop** command to camera at any time. The acquisition stop process is irrelevant to acquisition mode. But different stop time will result in different process, as shown in Figure 8-17 and Figure 8-18.

- Acquisition stop during reading out

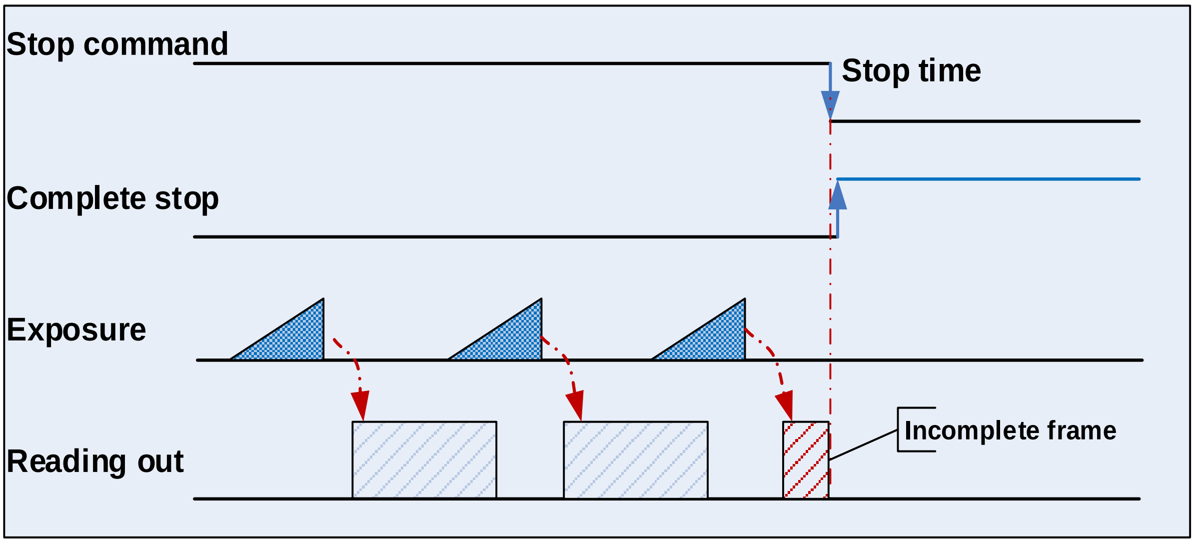


Figure 8-17 Acquisition stop during reading out

As shown in Figure 8-17, when the camera receives an **AcquisitionStop** command during reading out, it stops transferring frame data immediately. The currently transferred frame data is regarded as incomplete frame and will be discarded.

- **Acquisition stop during blanking**

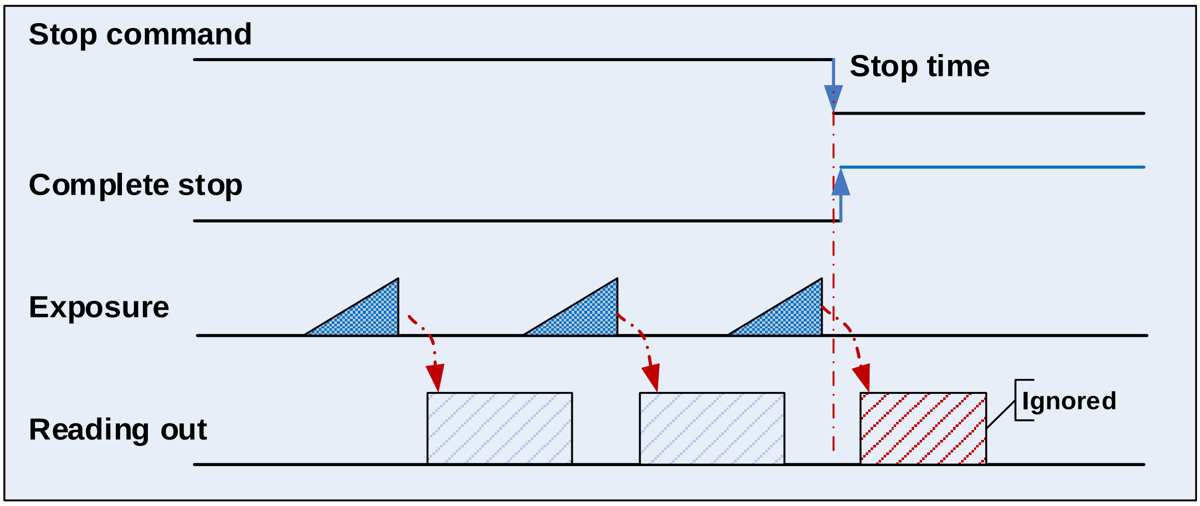


Figure 8-18 Acquisition stop during blanking

After the camera transferred a whole frame, the camera goes into wait state. When user sends an **AcquisitionStop** command in wait state, the camera will return to stop acquisition state. The camera will not send any frames even if it is just going to start the next exposing.

8.2.2. Acquisition Mode

Two camera acquisition modes are available: single frame acquisition mode and continuous acquisition mode.

- Single frame acquisition mode: In single frame acquisition mode, the camera will only acquire one frame of image at a time.

1) When the trigger mode is set to On, the trigger type is arbitrary

After executing the **AcquisitionStart** command, the camera waits for a trigger signal, which may be a software trigger or a hardware trigger of the camera. When the camera receives the trigger signal and acquires an image, the camera will automatically stop image acquisition. If you want to acquire another frame of image, you must execute the **AcquisitionStart** command again.

2) When the trigger mode is set to Off

After executing the **AcquisitionStart** command, the camera acquires one frame of image and then automatically stops image acquisition. If you want to acquire another frame of image, you must execute the **AcquisitionStart** command again.

In single frame acquisition mode, you must execute the **AcquisitionStop** command to set the functions that cannot be set in the acquisition status, such as ROI, packet size, etc.

- Continuous acquisition mode: In continuous acquisition mode, the camera continuously acquires and transmits images until the acquisition is stopped.

1) When the trigger mode is set to On, the trigger type is **FrameStart**

After executing the **AcquisitionStart** command, the camera waits for a trigger signal, which may be a software trigger or a hardware trigger of the camera. Each time the camera receives a trigger signal, it can acquire a frame of image until the **AcquisitionStop** command is executed. It is not necessary to execute the **AcquisitionStart** command every time.

2) When the trigger mode is set to On, the trigger type is **FrameBurstStart**

After executing the **AcquisitionStart** command, the camera waits for a trigger signal, which may be a software trigger or a hardware trigger of the camera. Each time the camera receives a trigger signal, it can continuously acquire the set **AcquisitionFrameCount** frames of image. If the **AcquisitionStop** command is received during the acquisition process, the image being transmitted may be interrupted, resulting in the number of images acquired this time not reaching the **AcquisitionFrameCount** frames of image (except for ME2L series).

3) When the trigger mode is set to Off

After executing the **AcquisitionStart** command, the camera will continuously acquire images until it receives the **AcquisitionStop** command.

You can check if the camera is in the waiting trigger status by the camera's trigger wait signal or by using the acquisition status function.

8.2.3. Trigger Type Selection

Two camera trigger types are available: **FrameStart** and **FrameBurstStart**. Different trigger types correspond to their respective set of trigger configurations, including trigger mode, trigger delay, trigger source, trigger polarity, and software trigger commands.

- FrameStart trigger mode

The **FrameStart** trigger is used to acquire one image. Each time the camera receives a **FrameStart** trigger signal, the camera begins to acquire an image.

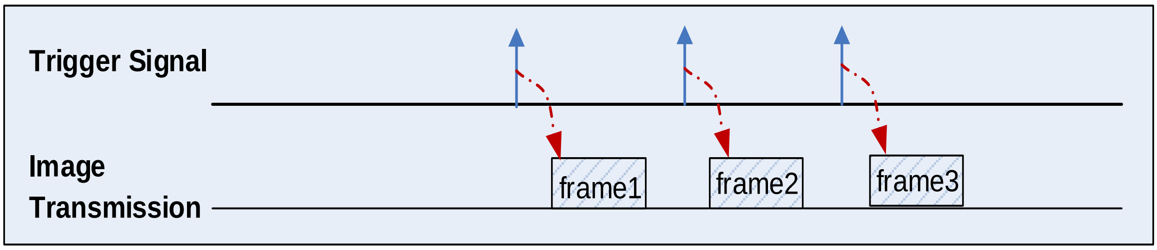


Figure 8-19 FrameStart trigger

- FrameBurstStart trigger mode

You can use the **FrameBurstStart** trigger signal to acquire a series of images ("continuous shooting" of the image). Each time the camera receives a **FrameBurstStart** trigger signal, the camera will start acquiring a series of images. The number of acquired image frames is specified by the "Acquisition burst frame count" parameter. The range of "Acquisition burst frame count" is 1~65535, and the default value is 1.

For example, if the "Acquisition burst frame count" parameter is set to 3, the camera automatically acquires 3 images. Then, the camera waits for the next **FrameBurstStart** trigger signal. After receiving the next trigger signal, the camera will take another 3 images, and so on.

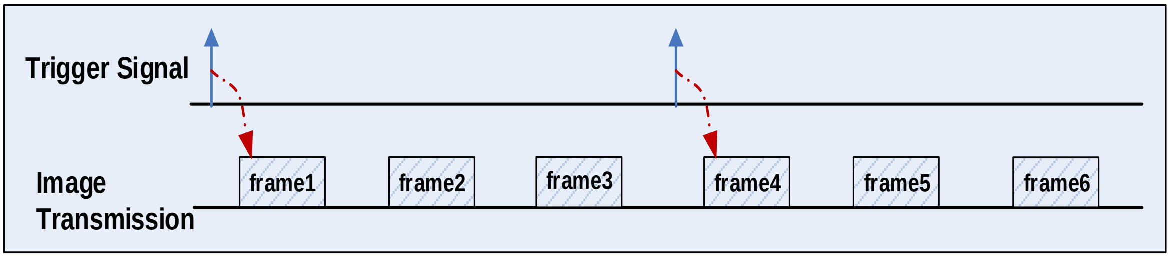


Figure 8-20 FrameBurstStart trigger

- FrameStart trigger mode and FrameBurstStart trigger mode are selected at the same time

If the **FrameStart** trigger mode and the **FrameBurstStart** trigger mode are selected at the same time, the trigger sequence is: first send the **FrameBurstStart** trigger signal, then send the **FrameStart** trigger signal. Each time a **FrameStart** trigger signal is sent, an image is acquired until the value of the "Acquisition burst frame count" parameter is reached.

For example, the **FrameStart** trigger mode and the **FrameBurstStart** trigger mode are selected at the same time. If the "Acquisition burst frame count" parameter is set to 3, when the camera receives a **FrameBurstStart** trigger signal, no image will be acquired. When the **FrameStart** trigger signal is received, the camera will acquire1 image, each time a **FrameStart** trigger signal is received, the camera will acquire 1 image. When 3 images are acquired, the camera will wait for the next **FrameBurstStart** trigger signal, and so on.

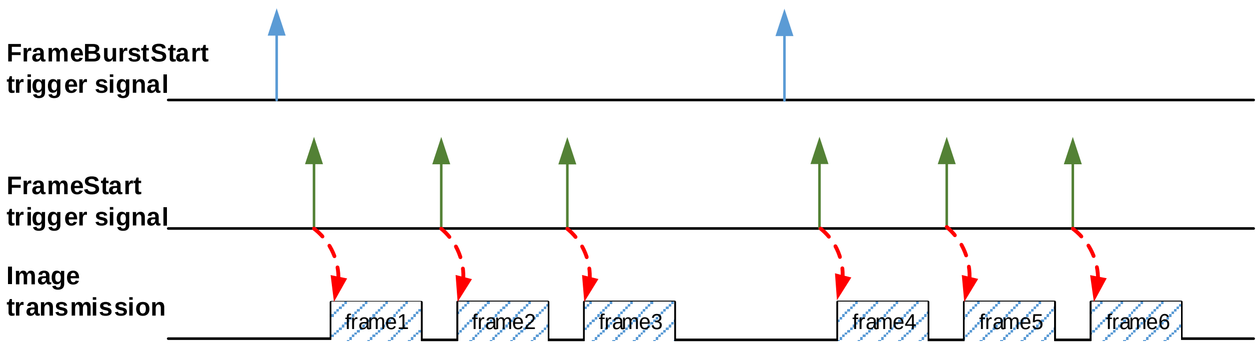


Figure 8-21 Two trigger modes are selected at the same time

8.2.4. Switching Trigger Mode

During the stream acquisition process, the user can switch the trigger mode of the camera without the **AcquisitionStop** command.

As shown below, switching the trigger mode at different positions will have different results.

- Switch trigger mode during frame reading out

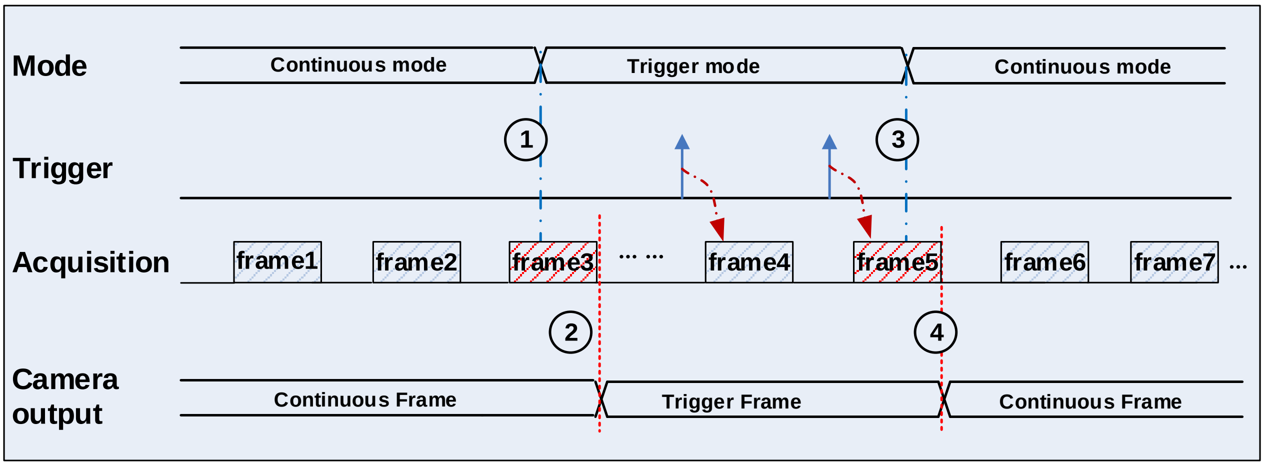


Figure 8-22 Switch trigger mode during frame reading out

As shown in Figure 8-22, the camera starts with trigger mode **OFF** after receiving acquisition start command.

At point 1, the camera gets a command of setting trigger mode **ON** while transferring the 3rd frame in trigger mode **OFF**. The trigger mode is not active until the 3rd frame is finished, at point 2, and then the trigger signal will be accepted. At point 3, the camera gets a command of switching back to **OFF**. It is also not active until the 5th frame is finished, it should wait a complete reading out. The camera switches from trigger mode to continuous mode at point 4, and then the camera works in continuous mode.

- **Switch trigger mode during blanking**

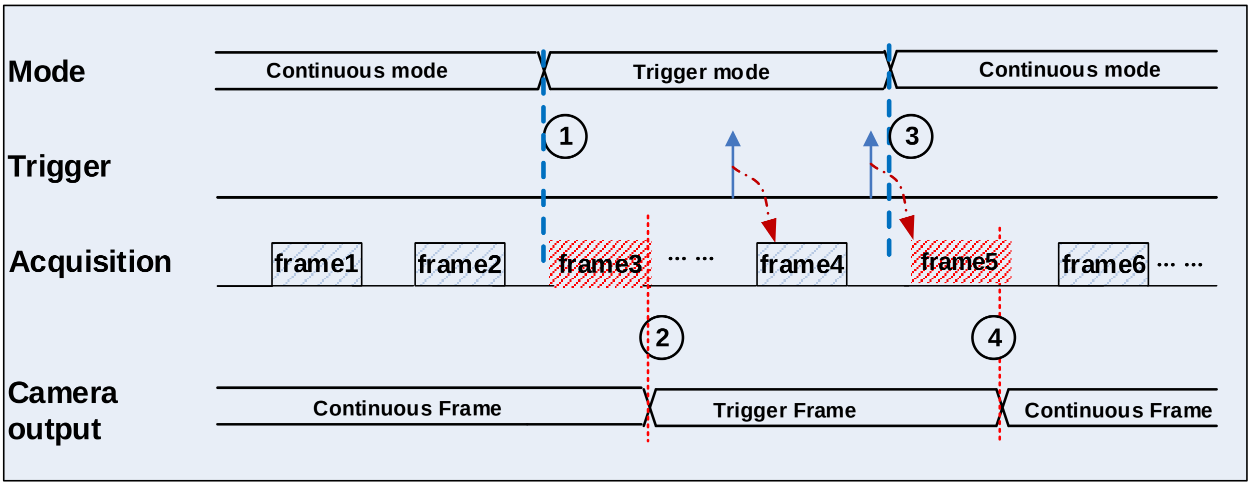


Figure 8-23 Switch trigger mode during blanking

As shown in Figure 8-23, the camera with trigger mode **OFF** begins after receiving an **AcquisitionStart** command.

At point 1, the camera gets a command of setting trigger mode **ON** while it is in wait state. The trigger mode is not active until the 3rd frame is finished, i.e., point 2. Please note that the 3rd frame does not belong to trigger mode. All trigger frames need trigger signals or software trigger commands. At point 3, the camera gets a command of switching back to continuous mode. It is also not active until the 5th frame is finished, it should wait a complete frame. The camera switches from trigger mode to continuous mode at point 4, and then the camera works in continuous mode.

8.2.5. Continuous Mode and Configuration

- Continuous mode configuration

The default value of **Trigger Mode** is **OFF** in default user set. If the camera is opened with default user set, the camera works in continuous mode directly. Otherwise, user can set **Trigger Mode** to **OFF** to work in continuous mode.

Other parameters also can be changed in **Trigger Mode OFF**.

- **Continuous mode features**

In continuous acquisition mode, the camera acquires and transmits images according to camera parameter set.

In continuous mode, ROI size may have effects on frame rate.

8.2.6. Acquisition Burst Mode

Acquisition burst mode setting is only applicable to trigger mode, and support three combinations:

1) Acquisition mode: Continuous, Trigger type: FrameStart ON / FrameBurstStart ON
2) Acquisition mode: Continuous, Trigger type: FrameStart ON / FrameBurstStart OFF
3) Acquisition mode: Continuous, Trigger type: FrameStart OFF / FrameBurstStart ON

Trigger types support software trigger and hardware trigger.

When FrameStart OFF / FrameBurstStart OFF, the maximum frame rate output by the camera is limited by the physical bandwidth of the USB 3.0 interface, so camera is under standard mode. In this mode, the frame rate is lower or equal to the current transmission capacity (influenced by the current exposure time, image size and other factors).

When the combination of trigger modes is any of the above three, the maximum frame rate output by the camera is not limited by the physical bandwidth of the USB 3.0 interface, and acquisition is conducted according to the maximum acquisition capacity of the sensor, and the frame rate is generally greater than the current transmission capacity (depends on sensor rate). Because of the acquisition bandwidth is greater than the transmission bandwidth, frame dropping may occur due to insufficient buffer.

When the acquisition burst mode enabled, due to the bandwidth difference of the sensor and the performance difference of the host computer, frame dropping may occur during long operation. To avoid this situation, the frame rate control switch should be enabled to limit the acquisition frame rate. The following table lists the cameras that support acquisition burst mode and the frames in various acquisition modes.

- Related Parameters

Continuous mode maximum frame rate: The maximum frame rate of camera when trigger mode and device bandwidth limit is OFF. Default full frame and short exposure time, and camera is limited by interface bandwidth at this time.

Trigger mode maximum frame rate: The maximum frame rate of camera when FrameStart or FrameBurstStart is ON. Default full frame and short exposure time, and camera is not limited by interface bandwidth at this time.

Acquisition burst mode permissible frames: To ensure that frame dropping could not occur, the maximum number of trigger signals (FrameStart ON / FrameBurstStart OFF and frame rate is equal to trigger mode maximum frame rate) or the maximum high-speed burst frames (FrameStart OFF / FrameBurstStart ON and camera is under FrameBurstStart trigger mode) of camera.

When the user sends the trigger signal to the camera at a frequency lower than the maximum frame rate of trigger mode, the permissible frame number for acquisition burst will be increased.

Camera models that support this feature and relevant parameters:

Model	Pixel formats (sensor bit depth)	Continuous mode maximum frame rate (fps)	Trigger mode maximum frame rate (fps)	Acquisition burst mode permissible frames
MER2-301-125U3M/C-HS	8bit	125.5	151.3	187
MER2-501-79U3M/C(-L)	8bit	78.9	81.2	564
	12bit	39.4	40.6	270
MER2-502-79U3M/C-HS MER2-502-79U3M-HS POL	8bit	79.16	96.84	87
	10bit	39.58	48.42	43
ME2S-560-70U3M/C	8bit	70.33	75.30	1087
	12bit	35.17	37.65	542
ME2S-1610-24U3M/C	8bit	24.49	32.94	124
	10/12bit	12.24	18.27	48
ME2S-2020-19U3M/C	8bit	19.47	26.07	63
	10/12bit	9.74	14.43	24
ME2S-2440-16U3M/C	8bit	16.09	21.95	59
	10/12bit	8.04	12.17	23
ME2S-2560-15U3M	8bit	15.4	21.95	38
	10/12bit	7.7	12.18	14

8.2.7. Software Trigger Acquisition and Configuration

- **Software trigger acquisition configuration**

The camera supports software trigger acquisition mode. Three steps followed should be ensured.

1) Set the Trigger Mode to ON.

2) Set the Trigger Source to Software.

3) Send Software Trigger command.

All the software trigger commands are sent by the host through the USB3.0 bus, to trigger the camera to acquire and transmit images.

- **Software trigger acquisition features**

In software trigger acquisition mode, the camera begins to acquire one image after receiving software trigger commands. In general, the number of frames is equal to the number of software trigger commands. The relative features are illustrated below:

1) In software trigger acquisition mode, if the trigger frequency is lower than permissible maximal FPS (Frame per Second) of the camera, the current frame rate is trigger frequency. If the trigger frequency is higher than permissible maximal FPS (Frame per Second) of the camera, some software triggers are ignored and the current frame rate is lower than trigger frequency.

2) The trigger delay feature can control the camera delay interval between your triggers and the camera acquiring frames. The default value of trigger delay time is zero.

8.2.8. Hardware Trigger Acquisition and Configuration

- **Hardware trigger acquisition configuration**

The camera supports hardware trigger acquisition mode. Three steps followed should be ensured:

1) Set the Trigger Mode to ON.

2) Set the Trigger Source to Line0, Line2 or Line3 (for MER2-6P/ME2L/ME2S cameras, set the Trigger Source to Line0 or Line2).

3) Connect hardware trigger signal to Line0.

If the Trigger Source is set by Line2 or Line3, it should be ensured that the corresponding Line is set as Input.

Please refer to section 8.1.1 for more information of the camera programmable GPIOs.

- **Hardware trigger acquisition features**

The relative features about the camera's trigger signal process are illustrated below:

1) The polarity of lines can be set to inverted or not inverted, and the default setting is not inverted.

2) Improper signal can be filtered by setting appropriate value to trigger filter. Raising edge filter and falling edge can be set separately. The range is from 0 to 5000 μs. The default configuration is not use trigger filter.

3) The time interval between trigger and exposure can be set through the trigger delay feature. The range of time interval covers from 0 to 3000000μs. The default value of trigger delay time is zero.

The features, like trigger polarity, trigger delay and trigger filter, can be select in the GalaxyView.

The camera's trigger source Line0 uses opto-isolated circuit to isolate signal. Its internal circuit delay trigger signal and rising edge's delay time is less than falling edge's. There are a dozen clock cycles delay of rising edge and dozens clock cycles delay of falling edge. If you use Line0 to trigger the camera, the positive pulse signal's positive width will be wider (about 20μs~40μs) and the negative pulse signal's negative width will be narrower (about 20μs~40μs). You can adjust filter parameter to accurately filter trigger signal.

8.2.9. Counter Trigger Acquisition and Configuration

- **Counter trigger configuration**

Some models support counter trigger acquisition mode. Two steps followed should be ensured.

1) Set the Trigger Mode to ON.

2) Set the Trigger Source to Counter2End.

To use counter trigger, the user need to set the parameters under the Counter And Timer Control category, like this:

1) Set the Counter to Counter2.

2) Set the CounterEventSource to Line0, Line2 or Line3 (Depending on the camera model) and the default value is OFF. Connect counter event trigger signal to cameras I/O port. When Line2 or Line3 is selected as CounterEventSource ,it need to be configured with input by LineMode

3) Set CounterDuration, the default value is 1 and the range is from 1 to 15000. Assuming that the parameter is set to n, then n times of the trigger signal can be executed for 1 time of the counter trigger, to acquire 1 frame image.

4) CounterValue: Read-only, displays the number of hardware trigger numbers that have been executed for each counter trigger.

5) Set CounterResetSource, the values that can be set are Off, SoftWare.

> 1) After the acquisition is stopped, the Counter2 will not continue to work, will not be cleared, and it will be cleared when the camera is started acquisition or powered off.
>
> 2) CounterReset is used to software reset the counter.
>
> 3) Counter2 value is cleared when the CounterEventSource or CounterDuration is switched.

- **Counter trigger acquisition features**

The relative features about the camera's counter trigger signal process are illustrated below:

1) Trigger polarity: The default value is RisingEdge. RisingEdge: Counter2 counts the I/O rising edge of the CounterEventSource, and when the value of Counter2 reaches CounterDuration, the generated trigger signal Counter2End is triggered at the rising edge. FallingEdge: Counter2 counts the I/O rising edge of the CounterEventSource, and when the value of Counter2 reaches CounterDuration, the generated trigger signal Counter2End is triggered at the falling edge.

2) Trigger filter: Improper signal can be filtered by setting appropriate value to trigger filter. Raising edge filter and falling edge can be set separately. The default configuration is not use trigger filter. Trigger filtering has a trigger delay effect. The I/O signal corresponding to the CounterEventSource is valid after filtering.

3) Trigger delay: Delayed trigger generates an image frame after the count value reaches the set value CounterDuration. The default value of trigger delay time is zero.

The features, like trigger polarity, trigger delay and trigger filter, can be select in the GalaxyView.

8.2.10. TriggerCache

- **Trigger cache usage configuration**

Some models support TriggerCache function, which can be set only in valid acquisition and trigger acquisition mode. All signal buffer will be cleared while in AcquisitionStop mode.

Firstly, set the TriggerMode as On. Choose one as TriggerSource from Line0, Line2 or Software, then set TriggerCacheEnable as true, and the trigger signals of the current trigger source will be buffered and the number of the TriggerCache signals is 16. These cached trigger signals will stimulate the sensor and transmit the image data to the user through the back-end.

For FrameStart and FrameBurstStart mode, there are two ways to buffer the trigger source separately.

- **TriggerDelay**

TriggerDelay is also abled in TriggerCache mode. The signals will be cached if there is a new signal coming to the corresponding line during the TriggerDelay process. The TriggerCache signals is still 16.

- **TriggerShield event**

When the trigger frequency is too high, the trigger buffer depth will be exceeded, which will cause TriggerShield event and then signal lost.

- **AcquisitionFrameRate**

The cached trigger signals will be output one by one, only when an effective trigger waiting signal is detected. Generally the cached trigger signals will trigger the sensor according to the sensor read limit frame cycle. However, when the frame rate control is effective, and the frame rate limit period is greater than the sensor read limit frame period, the cached trigger signal will trigger the sensor according to the frame rate limit frame period.

8.2.11. Overlapping Exposure and Non-overlapping Exposure

There are two stages in image acquisition of the MERCURY2 USB3 Vision camera: exposure and readout. Once the camera is triggered, it begins to integrate and when the integration is over, the image data will be read out immediately.

The MERCURY2 USB3 Vision camera supports two exposure modes: overlapping exposure and non-overlapping exposure. The user cannot assign the overlapping exposure or non-overlapping exposure directly, it depends on the frequency of trigger signal and the exposure time. The two exposure mode are described as below.

- Non-overlapping exposure

In non-overlapping exposure mode, after the exposure and readout of the current frame are completed, then the next frame will expose and read out. As shown in the Figure 8-24, the N^{th} frame is read out, after a period of time, the $N+1^{th}$ frame to be exposed.

The formula of non-overlapping exposure frame period:

non-overlapping exposure frame period > exposure time + readout time

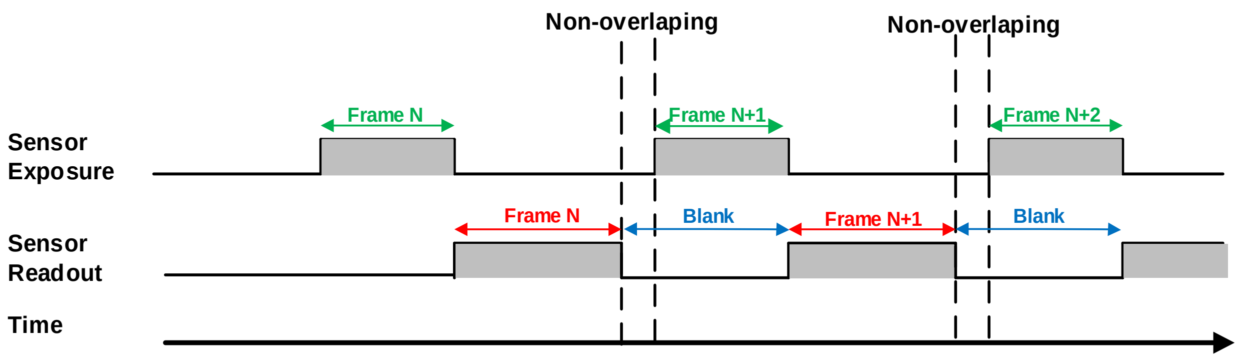


Figure 8-24 The exposure sequence diagram in non-overlapping exposure mode

- **Trigger acquisition mode**

If the interval between two triggers is greater than the sum of the exposure time and readout time, overlapping exposure will not occur, as shown in Figure 8-25.

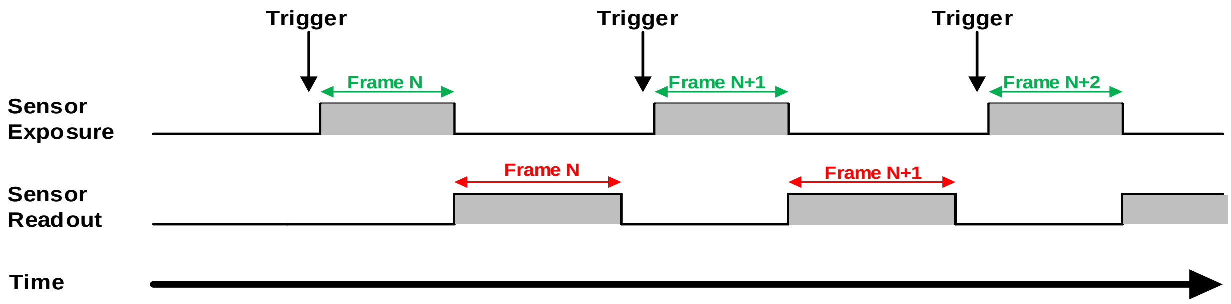


Figure 8-25 The trigger acquisition exposure sequence diagram in non-overlapping exposure mode

- **Overlapping exposure**

In overlapping exposure mode, the current frame image exposure process is overlap with the readout of the previous frame. That is, when the previous frame is reading out, the next frame image has been started exposure. As shown in the Figure 8-26, when the Nth frame image is reading out, the N+1th frame image has been started exposure.

The formula of overlapping exposure frame period:

$$\text{overlapping exposure frame period} \leq \text{exposure time} + \text{readout time}$$

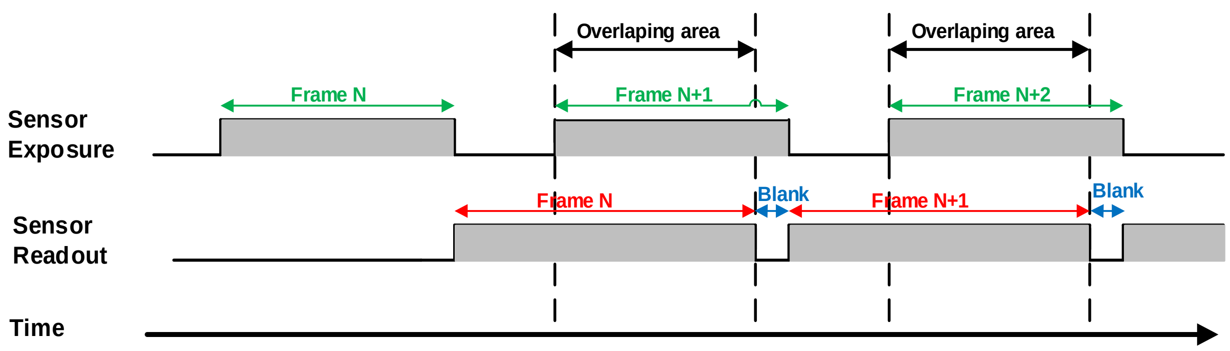


Figure 8-26 The exposure sequence diagram in overlapping exposure mode

- **Continuous acquisition mode**

If the exposure time is greater than the frame blanking time, the exposure time and the readout time will be overlapped. As shown in the Figure 8-26.

- **Trigger acquisition mode**

When the interval between two triggers is less than the sum of exposure time and the readout time, overlapping exposure will occur, as shown in Figure 8-27.

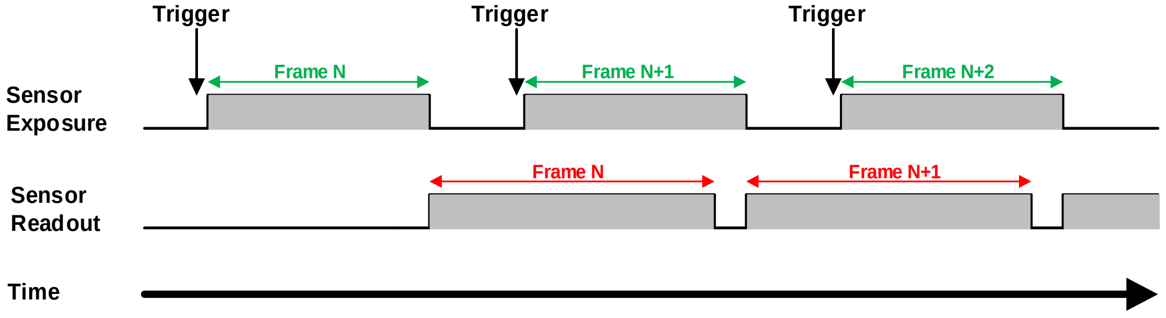


Figure 8-27 The trigger acquisition exposure sequence diagram in overlapping exposure mode

Compared with non-overlapping exposure mode, in overlapping exposure mode, the camera can obtain higher frame rate.

8.2.12. Set Exposure

8.2.12.1. Set Exposure Mode

Two Exposure Mode are available: Timed exposure mode and TriggerWidth exposure mode. Among them, the TriggerWidth exposure mode determines the exposure time when the camera is configured for hardware triggering. And the exposure time depends on the width of the trigger signal, which is triggered by the rising edge (falling edge) set by the Trigger Activation.

1) Timed exposure mode

Timed exposure mode is available on all camera models. In this mode, the exposure time is determined by the camera's Exposure Time setting. If the camera is configured for software triggering, exposure starts when the software trigger signal is received and continues until the exposure time has expired.

If the camera is configured for hardware trigger:

- If rising edge triggering is enabled, exposure starts when the trigger signal rises and continues until the exposure time has expired, as shown in Figure 8-28

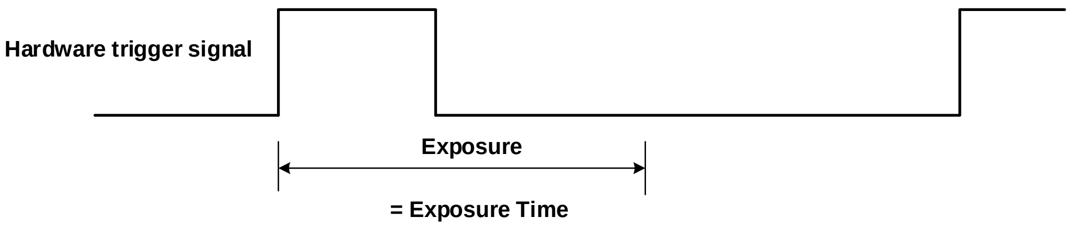


Figure 8-28 The sequence diagram in rising edge trigger of Timed exposure mode

- If falling edge triggering is enabled, exposure starts when the trigger signal falls and continue until the exposure time has expired, as shown in Figure 8-29

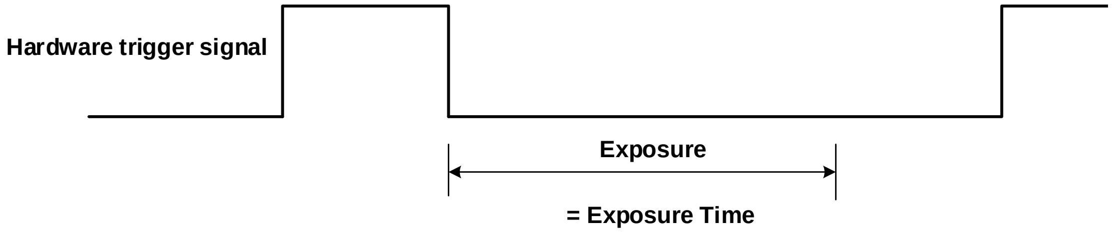


Figure 8-29 The sequence diagram in falling edge trigger of Timed exposure mode

Avoid overtriggering in Timed exposure mode. If the Timed exposure mode is enabled, do not attempt to send a new trigger signal while the previous exposure is still in progress. Otherwise, the trigger signal will be ignored, and a FrameStartOvertrigger event will be generated.

2) TriggerWidth exposure mode

In TriggerWidth exposure mode, the length of exposure is determined by the width of the hardware trigger signal. This function can meet the needs of users to change the exposure time of each frame of image.

- If rising edge triggering is enabled, exposure starts when the trigger signal rises and continue until the trigger signal falls, as shown in Figure 8-30

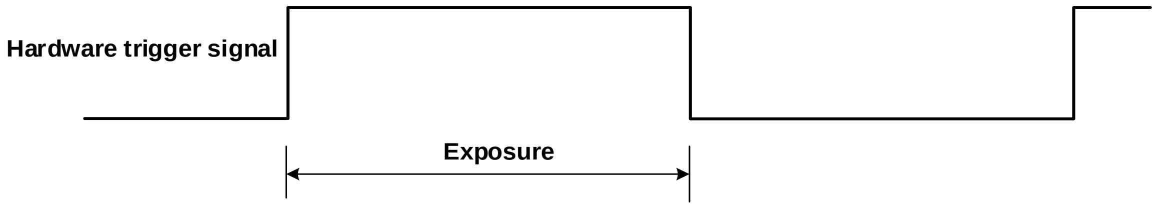


Figure 8-30 The sequence diagram in rising edge trigger of TriggerWidth exposure mode

- If falling edge triggering is enabled, exposure starts when the trigger signal falls and continue until the trigger signal rises, as shown in Figure 8-31

Figure 8-31 The sequence diagram in falling edge trigger of TriggerWidth exposure mode

Avoid overtriggering in TriggerWidth exposure mode. If the TriggerWidth exposure mode is enabled, do not send trigger signals at too high a rate. Otherwise, trigger signals will be ignored, and a FrameStartOvertrigger event will be generated.

The Exposure Overlap Time Max feature can optimize the acquisition of overlapping images. This parameter is especially useful if the user wants to maximize the camera's frame rate, i.e., if the user wants to trigger at the highest rate possible.

- **Prerequisites**

a) Set the TriggerMode parameter to On.

b) Set the TriggerSource parameter to one of the available hardware trigger source, e.g., Line0.

c) Set the ExposureMode parameter to TriggerWidth exposure mode.

- **How it works**

The user can use overlapping image acquisition to increase the frame rate of the camera. With overlapping image acquisition, the exposure of a new image begins while the camera is still reading out the sensor data of the previous image.

In TriggerWidth exposure mode, the camera does not "know" how long the image will be exposed before the trigger period is complete. Therefore, the camera cannot fully optimize overlapping image acquisition. To avoid this problem, the user can enter a value for the ExposureOverlapTimeMax parameter, which represents the shortest exposure time the user intends to use (in μs). This helps the camera optimize the overlapping image acquisition.

- **Set ExposureOverlapTimeMax**

To optimize the frame rate of the camera, the exposure mode should be set to TriggerWidth:

a) Set the ExposureMode parameter to TriggerWidth.

b) Enter a value for the ExposureOverlapTimeMax parameter, which represents the shortest exposure time the user intends to use (in μs).

Example: Assume that the user wants to trigger the camera to apply exposure times in the range of 3000 μs to 5500 μs, the user needs to set the ExposureOverlapTimeMax parameter of the camera to 3000.

The trigger signal width of the hardware triggering should not be shorter than the value of the entered ExposureOverlapTimeMax parameter.

8.2.12.2. Set Exposure Value

- **Global Shutter**

The implementation process of global shutter is as shown in Figure 8-32, all the lines of the sensor are exposed at the same time, and then the sensor will read out the image date one by one.

The advantage of the global shutter is that all the lines are exposed at the same time, and the images do not appear offset and distortion when capturing moving objects.

The time width of the flash signal can be got by the following formula:

$$T_{strobe} = T_{exposure}$$

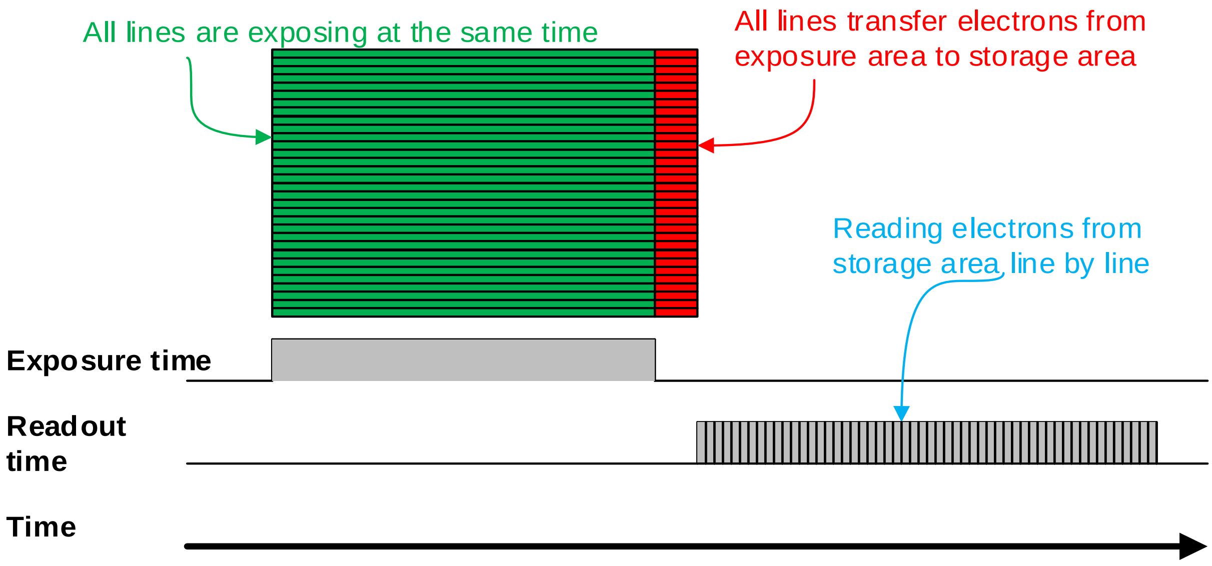


Figure 8-32 Global shutter

- **Electronic Rolling Shutter**

The implementation process of electronic rolling shutter is as shown in Figure 8-33, different from the global shutter, electronic rolling shutter exposures from the first line, and starts the second line exposure after a row period. And so on, after N-1 line, the N line starts exposing. When the first line exposure ends, it begins to read out the data, and it need a row period time to read out one line (including the line blanking time). When the first line reads out completely, the second line just begins to read out, and so on, when the N-1 line is read out, the N line begins to read out, until the whole image is read out completely.

The electronic rolling shutter has low price and high resolution, which is a good choice for some static image acquisition.

The time width of the flash signal can be got by the following formula:

$$T_{strobe} = T_{exposure} - (N - 1) \times T_{row}$$

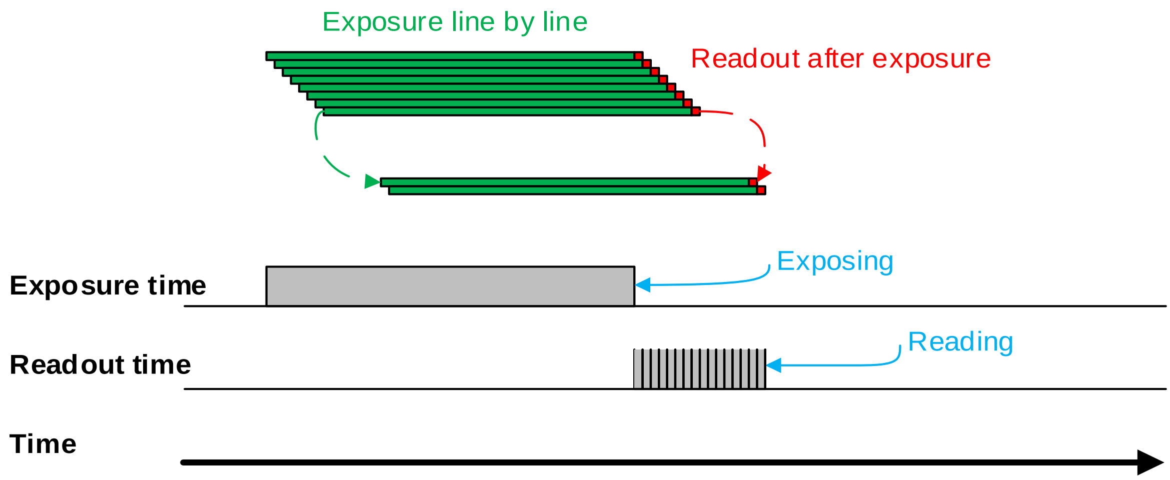


Figure 8-33 Electronic rolling shutter

- **Global Reset Release Shutter**

As the sensor starts exposure line by line, all of the pixels in the sensor start exposing at the same time. However, the end time of upper lines and lower lines of the same frame of image is different when capturing fast moving objects, so the distortion will occur. The Global Reset Release (GRR) shutter mode can effectively avoid the distortion. If the camera is operated in the GRR shutter mode, you must use flash lighting.

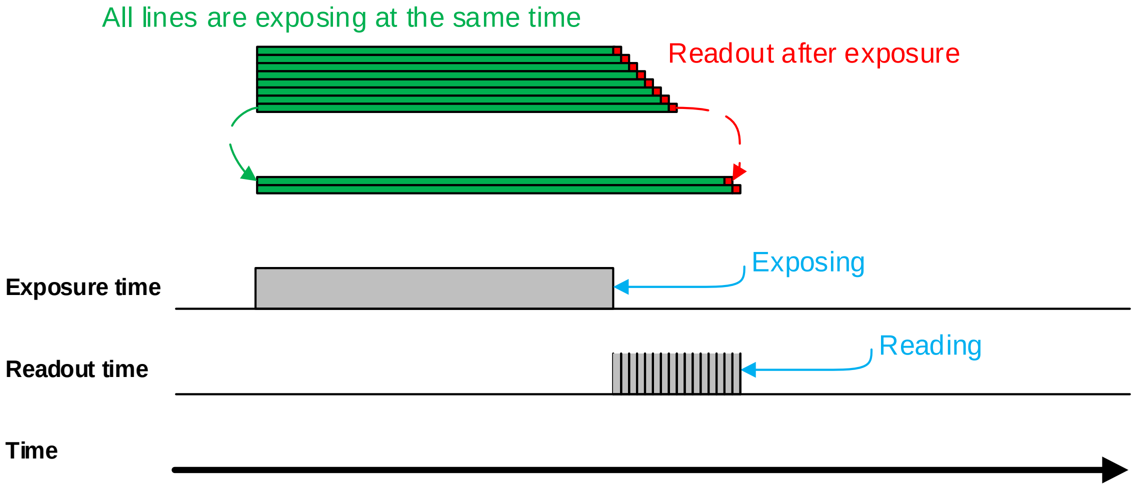


Figure 8-34 Global Reset Release shutter

Line-by-line exposure sensor starts exposure at the same time in GRR mode, and the exposure ends successively from top to bottom. As shown in the Figure 8-34, the exposure time is the common exposure interval, which is also the interval that the flash lighting needs to be opened. That is, the exposure time signal goes high when you can start the flash lighting, and the exposure time signal goes low when you should stop the flash lighting. Otherwise, the brightness in the acquired images will vary significantly from top to bottom due to the differences in the exposure time of the individual lines. In addition, the image will be distortional due to different exposure end time of the individual lines.

The exposure delay is supported in GRR mode. At the same time, there is a certain delay due to the flash lighting, and the actual duration of the flash is as follows:

$$T_{strobe} = T_{exposure} + T_{exp\_delay} + T_{row} \times 18$$

Settings:

1) Set the SensorShutterMode to Global Reset.
2) Connect the camera to the flash lighting.

8.2.12.3. Exposure Time Mode

According to the length of the exposure time, two exposure time modes of the MERCURY2 USB3 Vision camera are available: Standard exposure time mode and UltraShort exposure time mode.

In Standard exposure time mode, three exposure time adjustment modes are available: manual adjustment, one-time automatic adjustment and continuous automatic adjustment. The standard exposure time mode is the default setting. For the manual adjustment, please refer to section 8.2.9. For the automatic adjustment and continuous automatic adjustment, please refer to section 8.3.5.

In UltraShort exposure time mode, the MERCURY2 USB3 Vision camera only supports manual adjustment of the exposure time. Since standard exposure time mode is the default setting, if you want to set the UltraShort exposure time mode, you first need to adjust the visibility level to guru and set the ExposureTimeMode to UltraShort under the acquisition control features window.

In UltraShort exposure time mode, the MERCURY2 USB3 Vision camera does not support automatic adjustment of the exposure time, only support manual adjustment of the exposure time.

8.2.12.4. Set Exposure Time

The MERCURY2 USB3 Vision camera supports setting the exposure time, step: 1μs.

The exposure precision of the camera is limited by the sensor, when the steps in the user's interface and the demo display as 1μs, actually the steps are one row period. When the value of the ExposureTime cannot be divisible by the row period, round up to an integer should be taken, such as the row period is 36μs, setting exposure time to 80μs, and the actual exposure time is 108μs.

When the external light source is sunlight or direct current (DC), the camera has no special requirements for the exposure time. When the external light source is alternating current (AC), the exposure time must synchronize with the external light source (under 50Hz light source, the exposure time must be a multiple of 1/100s, under 60Hz light source, the exposure time must be a multiple of 1/120s), to ensure better image quality. You can set the exposure time that is synchronized with the external light source by using the demo or interface function.

The MERCURY2 USB3 Vision camera supports Auto Exposure feature. If the Auto Exposure feature is enabled, the camera can adjust the exposure time automatically according to the environment brightness. See section 8.3.5 for more details.

8.2.13. Exposure Delay

The exposure delay function can effectively solve the strobe delay problem. Most strobes have a delay of at least tens of microseconds from trigger to light. When the camera is working in a small exposure mode, the fill light effect of the strobe will be affected. The exposure delay is achieved by the strobe signal and the delay of the actual exposure starting.

The unit of exposure delay is μs, the range is 0 ~ 5000μs, and the minimum value is 0.

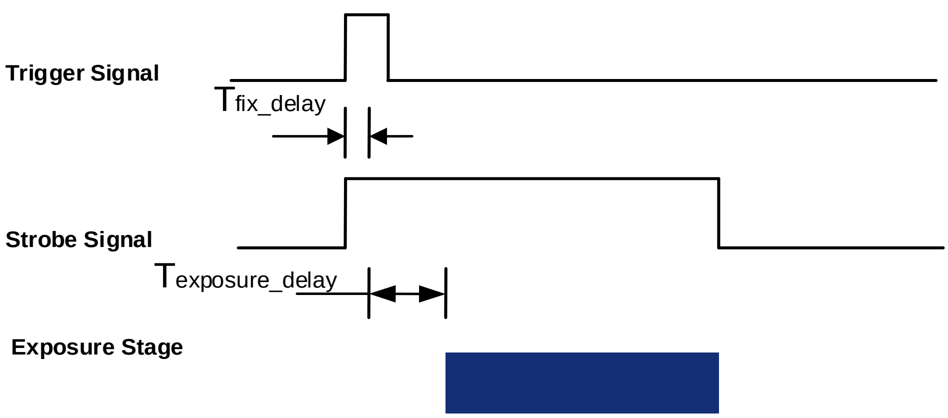


Figure 8-35 The exposure delay sequence diagram in overlaping exposure mode

When a hardware trigger signal is received to the sensor to start exposure, there is a small delay, which is called the exposure delay and consists of four parts of time, as shown in Figure 8-36.

T1: The delay introduced by the hardware circuit when the external signal passes through the optocoupler or GPIO. The value is generally in the range of several to several tens of μs. The delay is mainly affected by the connection mode, driving intensity and temperature. When the external environment is constant, the delay is generally stable.

T2: Delay introduced by the trigger filter. For example, if the trigger filter time is set to 50μs, T2 is 50μs.

T3: Trigger delay (trigger_delay), the camera supports trigger delay feature. If the trigger delay is set to 200μs, T3 is 200μs.

T4: The sensor timing sequence delay, the internal exposure of the sensor is aligned with the row timing sequence, so T4 has a maximum row cycle jitter. The value of each sensor is different. Some products with large delay time (several hundred μs or more) have additional configuration time counted in T4.

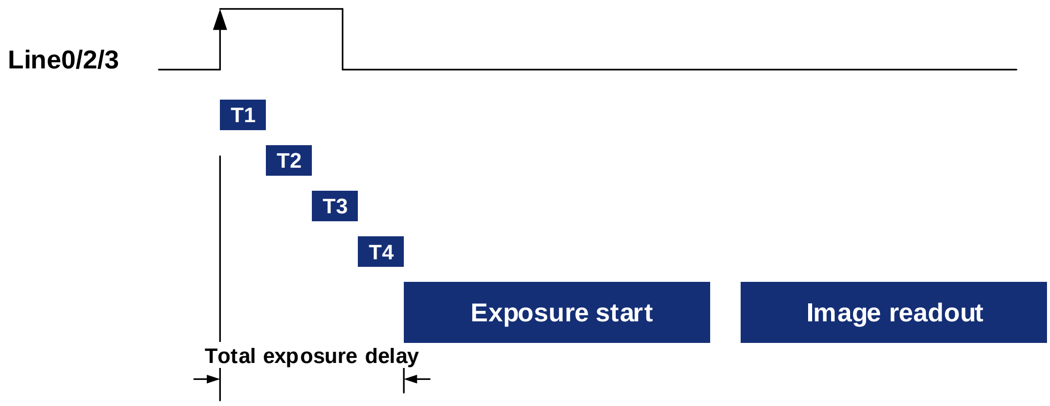


Figure 8-36 Exposure delay

The following table shows the total exposure delay time for each sensor.

T1 is calculated according to the typical delay (5μs) of line0. If it is line2/3, T1 can be ignored.

T2 is calculated as 0μs.

T3 is calculated as 0μs.

T4 is calculated according to the ROI settings and features of each sensor.

The exposure delay data for each model is as follows:

Model	Exposure Delay (μs)
MER2-041-436U3M/C	Mono8/BayerRG8: 13~17
MER2-041-528U3M/C	BPP8: 11.5, BPP10: 12.85, BPP12: 15.7
MER2-060-642U3M	Mono8: 8.6, Mono10: 12.2
MER2-135-150U3M/C	13.63

MER2-135-208U3M/C	Mono8/BayerBG8: 10.08, Mono10/BayerBG10: 13.53
MER2-160-227U3M/C	Mono8/BayerRG8: 12.85, Mono10/BayerRG10: 20.7
MER2-230-168U3M/C	Mono8/BayerRG8: 14.6, Mono10/BayerRG10: 24.2
MER2-231-41U3M/C	44.8
MER2-240-159U3M/C	Mono8/BayerGB8: 20.075 Mono10/Mono12/BayerGB10/BayerGB12: 35.15
MER2-280-139U3M/C	Mono8/BayerRG8: 28.5 Mono10/Mono12/BayerRG10/BayerRG12: 55
MER2-301-125U3M/C	Mono8/BayerRG8: 15.15, Mono10/BayerRG10: 25.3
MER2-302-56U3M/C	27.6
MER2-303-107U3M/C	Mono8/BayerRG8: 16.8, Mono12/BayerRG12: 28.6
MER2-304-56U3M/C	27.6
MER2-501-79U3M/C	Mono8/BayerRG8: 11.8, Mono12/BayerRG12: 23.6
MER2-502-79U3M/C	Mono8/BayerRG8: 17, Mono10/BayerRG10: 29
MER2-502-79U3M POL	Mono8: 17, Mono10: 29
MER2-503-36U3M/C	31.6
MER2-503-36U3M POL	31.6
MER2-510-36U3M/C	31.6
MER2-630-60U3M/C	BayerRG8/Mono8: 2357, BayerRG10/Mono10: 2707
MER2-1220-32U3M/C	Mono8/BayerRG8: 650, Mono12/BayerRG12: 1260
MER2-2000-19U3M/C	Mono8/BayerRG8: 800, Mono12/BayerRG12: 1550
MER2-2002-20U3M/C	BayerGR8/Mono8: 12.43, BayerGR10/Mono10: 24.87
MER2-041-608U3M/C-HS	BPP8: 10.65, BPP10: 12, BPP12: 14.15
MER2-160-249U3M/C-HS	Mono8/BayerRG8(BPP8): 12.15, Mono8/BayerRG8(BPP10): 12.85, Mono10/BayerRG10: 20.7, Mono12/BayerRG12: 20.7
MER2-301-125U3M/C-HS	Mono8/BayerRG8(BPP8): 13.4, Mono8/BayerRG8(BPP10): 15.15, Mono10/BayerRG10: 25.3, Mono12/BayerRG12: 25.3
MER2-502-79U3M/C-HS	Mono8/BayerRG8: 14.9, Mono10/BayerRG10: 24.8
MER2-502-79U3M-HS POL	Mono8: 14.9, Mono10: 24.8
MER2-041-608U3M/C-HS-6P	BPP8: 10.65, BPP10: 12, BPP12: 14.15

MER2-160-249U3M/C-HS-6P	Mono8/BayerRG8(BPP8): 12.15, Mono8/BayerRG8(BPP10): 12.85, Mono10/BayerRG10: 20.7, Mono12/BayerRG12: 20.7
ME2S-560-70U3M/C	23~41
ME2S-1260-28U3M/C	BayerRG8/Mono8: 51.6, BayerRG12/Mono12: 97.6
ME2S-1610-24U3M/C	Mono8/BayerRG8: 82.2 Mono10/Mono12/ BayerRG10/BayerRG12: 144.2
ME2S-2020-19U3M/C	Mono8/BayerRG8: 71.4 Mono10/Mono12/ BayerRG10/BayerRG12: 125
ME2S-2440-16U3M/C	Mono8/BayerRG8: 82.2 Mono10/Mono12/ BayerRG10/BayerRG12: 144.2
ME2S-2560-15U3M/C	Mono8/BayerRG8: 91.85 Mono10/Mono12/BayerRG10/BayerRG12: 161.6
ME2S-138-136U3M-SWIR	BPP8: 12, BPP10: 12.5, BPP12: 18.1
ME2S-138-232U3M-SWIR	BPP8: 9.1, BPP10: 9.4, BPP12: 12.5
ME2P-530-72U3M NIR ME2P-530-72U3C	24.8
ME2P-170-210U3M/C	Mono8/BayerRG8: 40.1 Mono10/Mono12/BayerRG10/BayerRG12: 75.2
ME2P-560-36U3M/C	30~56
ME2P-883-42U3M/C	Mono8/BayerRG8: 26.6, Mono12/BayerRG12: 48.2
ME2P-900-43U3M/C	25~46
ME2P-1230-23U3M/C	Mono8/BayerRG8: 33, Mono12/BayerRG12: 61
ME2P-1231-32U3M/C	Mono8/BayerRG8: 23.8 Mono10/BayerRG10/Mono12/BayerRG12: 42.6
ME2P-1231-32U3M POL	Mono8: 23.8, Mono10/Mono12: 42.6
ME2P-1840-21U3M/C	25~46
ME2P-2621-15U3M/C	25~67
ME2P-2621-15U3M NIR	25~67
ME2P-2622-15U3M/C	25~67
ME2P-2622-15U3M NIR	25~67
ME2P-1230-30U3M/C-HS	Mono8/BayerRG8: 26.6，Mono12/BayerRG12: 48.2
ME2L-042-121U3M/C	28.8~43.2

ME2L-161-61U3M	BayerRG8/Mono8: 33.44~49.16, BayerRG10/Mono10: 62.88~93.32
ME2L-203-76U3M/C	BayerRG8/Mono8: 368, BayerRG10/Mono10: 737
ME2L-204-76U3M/C(-L)-F02	BayerRG8/Mono8: 368, BayerRG10/Mono10: 737
ME2L-505-36U3M/C	BayerRG8/Mono8: 27254, BayerRG10/Mono10: 27567
ME2L-830-22U3M/C	BayerRG8/Mono8: 32483, BayerRG10/Mono10: 32729

Table 8-2 Camera exposure delay range

8.3. Basic Features

8.3.1. Gain

The MERCURY2 USB3 Vision camera can adjust the analog gain, and the range of analog gain as shown in section 4 General Specification. When the analog gain changes, the response curve of the camera changes, as shown in Figure 8-37.

The horizontal axis represents the output signal of the sensor in the camera, and the vertical axis represents the gray value of the output image. When the amplitude of the sensor output signal remains constant, increasing the gain makes the response curve steeper, and that makes the image brighter. For every 6dB increases of the gain, the gray value of the image will double. For example, when the camera has a gain of 0dB, the image gray value is 126, and if the gain is increased to 6dB, the image gray will increase to 252. Thus, increasing gain can be used to increase image brightness. When the environment brightness and exposure time keep constant, another way to increase the image brightness is to change the camera's digital gain by modifying the lookup table, for more details please see section 8.4.5. Note that increasing the analog gain or digital gain will amplify the image noise.

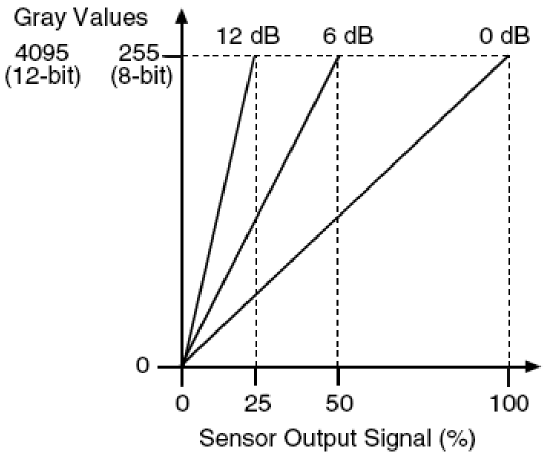


Figure 8-37 The cameras response curve

8.3.2. Sensor Bit Depth

By setting the "Sensor Bit Depth", the user can change the bit depth of the sensor output data. Reducing the sensor bit depth improves the camera frame rate, and increasing the sensor bit depth improves the image quality.

The sensor bit depth function is associated with the pixel format. When the pixel format is 8bit, the sensor bit depth can be selected as BPP8 or BPP10. When the pixel format is 10bit, the sensor bit depth only supports BPP10. When the pixel format is 12bit, the sensor bit depth only supports BPP12. The sensor bit depth depend on the monochrome or color camera model. The following table shows the sensor bit depth supported by the camera.

Model	Sensor Bit Depth
MER2-041-528U3M/C(-L)	BPP8, BPP10, BPP12
MER2-041-608U3M/C(-L)-HS	BPP8, BPP10, BPP12
MER2-160-249U3M/C(-L)-HS	BPP8, BPP10, BPP12
MER2-280-139U3M/C(-L)	BPP10, BPP12
MER2-301-125U3M/C(-L)-HS	BPP8, BPP10, BPP12
MER2-041-608U3M/C(-L)-HS-6P	BPP8, BPP10, BPP12
MER2-160-249U3M/C(-L)-HS-6P	BPP8, BPP10, BPP12
ME2P-170-210U3M/C	BPP10, BPP12
ME2P-1231-32U3M/C	BPP8, BPP10, BPP12
ME2P-1231-32U3M POL	BPP8, BPP10, BPP12
ME2S-1610-24U3M/C	BPP8, BPP10, BPP12
ME2S-2020-19U3M/C	BPP8, BPP10, BPP12
ME2S-2440-16U3M/C	BPP8, BPP10, BPP12
ME2S-2560-15U3M	BPP8, BPP10, BPP12
ME2S-138-136U3M-SWIR	BPP8, BPP10, BPP12
ME2S-138-232U3M-SWIR	BPP8, BPP10, BPP12

Table 8-3 Sensor bit depth that the MERCURY2 USB3 Vision camera supported

8.3.3. Pixel Format

By setting the pixel format, the user can select the format of output image. The available pixel formats depend on the camera model and whether the camera is monochrome or color. The following table shows the pixel format supported by the camera.

The image data starts from the upper left corner, and each pixel is output brightness value of each pixel line from left to right and from top to bottom.

- **Mono8**

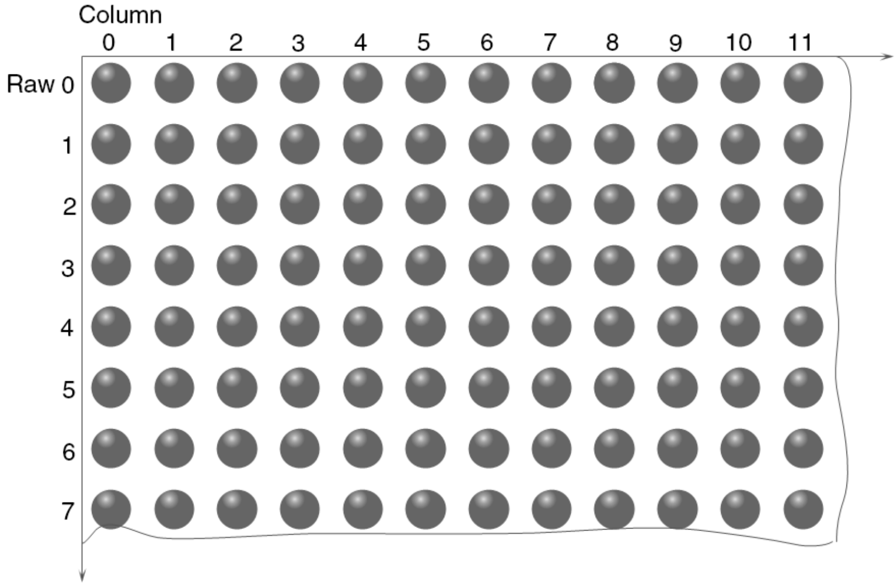


Figure 8-38 Mono8 pixel format

When the pixel format is set to Mono8, the brightness value of each pixel is 8 bits. The format in the memory is as follows:

Y00	Y01	Y02	Y03	Y04	……
Y10	Y11	Y12	Y13	Y14	……
……					

Among them Y00, Y01, Y02 … are the gray value of each pixel that starts from the first row of the image. Then the gray value of the second row pixels of the images is Y10, Y11, and Y12…

- **Mono10/Mono12**

When the pixel format is set to mono10 or Mono12, each pixel is 16 bits. When Mono10 is selected, the effective data is only 10 bits, the six unused most significant bits are filled with zero. When Mono12 is selected, the effective data is only 12 bits, the 4 of the MSB 16 bits data are set to zero. Note that the brightness value of each pixel contains two bytes, arranged in little-endian mode. The format is as follows:

Y00	Y01	Y02	Y03	Y04	……
Y10	Y11	Y12	Y13	Y14	……
……					

Among them Y00, Y01, Y02…are the gray value of each pixel that start with the first row of the image. The first byte of each pixel is low 8 bits of brightness, and the second byte of each pixel is high 8 bits of brightness.

- **BayerRG8**

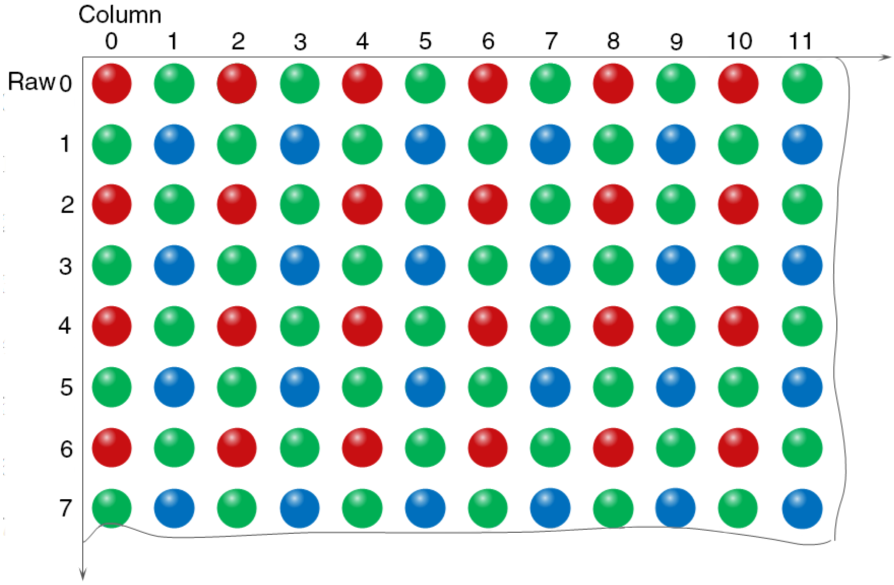


Figure 8-39 BayerRG8 pixel format

When the pixel format is set to BayerRG8, the value of each pixel in the output image of the camera is 8 bits. According to the location difference, the three components of red, green and blue are respectively represented. The format in the memory is as follows:

R00	G01	R02	G03	R04	……
G10	B11	G12	B13	G14	……
……					

Where R00 is the first pixel value of the first row (for the red component), G01 represents the second pixel value (for the green component), and so on, so that the first row pixel values are arranged. G10 is the first pixel value of the second row (for the green component), the B11 is the second pixel value (for the blue component), and so on, and the second row of pixel values are arranged.

- **BayerRG10/BayerRG12**

When the pixel format is set to BayerRG10 or BayerRG12, the value of each pixel in the output image of the camera is 16 bits. According to the location difference, the three components of red, green and blue are respectively represented. The format in the memory is as follows:

R00	G01	R02	G03	R04	……
G10	B11	G12	B13	G14	……
……					

Each pixel is the same as BayerRG8, the difference is that each pixel is made up of two bytes, the first byte is the low 8 bits of the pixel value, and the second byte is the high 8 bits of the pixel value.

- **BayerGR8**

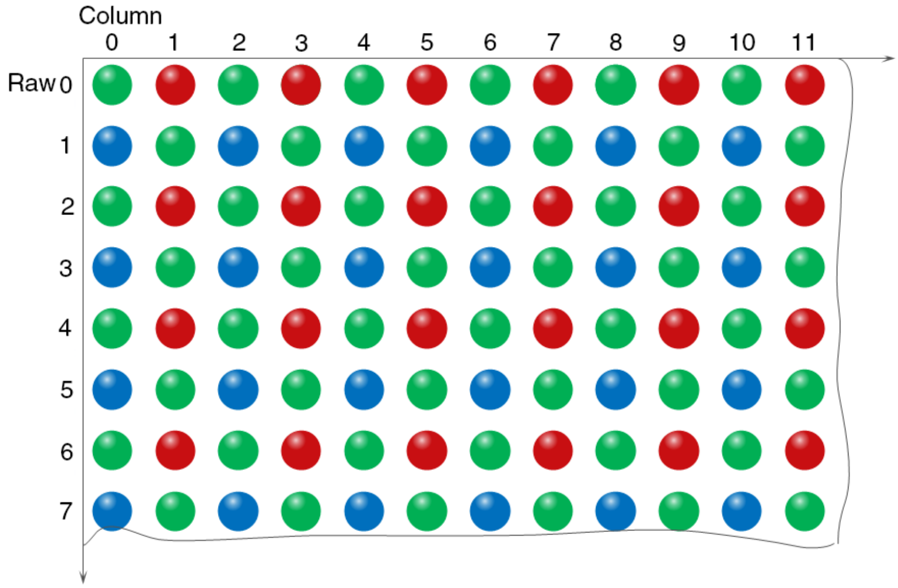


Figure 8-40 BayerGR8 pixel format

When the pixel format is set to BayerGR8, the value of each pixel in the output image of the camera is 8 bits. According to the location difference, the three components of red, green and blue are respectively represented. The format in the memory is as follows:

G00	R01	G02	R03	G04	……
B10	G11	B12	G13	B14	……
……					

Where G00 is the first pixel value of the first row (for the green component), R01 represents the second pixel value (for the red component), and so on, so that the first row pixel values are arranged. B10 is the first pixel value of the second row (for the blue component), the G11 is the second pixel value (for the green component), and so on, and the second row of pixel values are arranged.

- **BayerGR10/BayerGR12**

When the pixel format is set to BayerGR10 or BayerGR12, the value of each pixel in the output image of the camera is 16 bits. According to the location difference, the three components of red, green and blue are respectively represented. The format in the memory is as follows:

G00	R01	G02	R03	G04	……
B10	G11	B12	G13	B14	……
……					

Each pixel is the same as BayerRG8, the difference is that each pixel is made up of two bytes, the first byte is the low 8 bits of the pixel value, and the second byte is the high 8 bits of the pixel value.

- **BayerGB8**

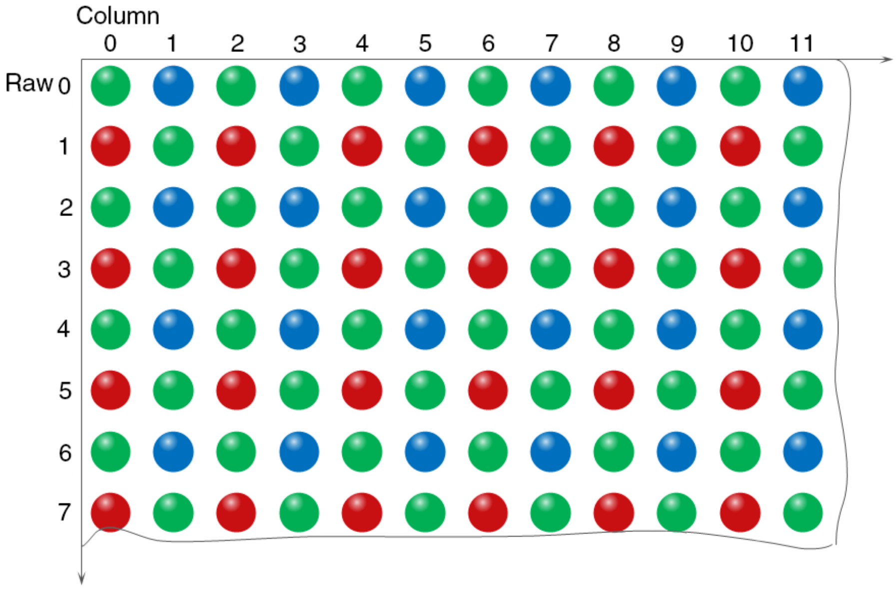


Figure 8-41 BayerGB8 pixel format

When the pixel format is set to BayerRG8, the value of each pixel in the output image of the camera is 8 bits. According to the location difference, the three components of red, green and blue are respectively represented. The format in the memory is as follows:

G00	B01	G02	B03	G04	……
R10	G11	R12	G13	R14	……
……					

Where G00 is the first pixel value of the first row (for the green component), B01 represents the second pixel value (for the blue component), and so on, so that the first row pixel values are arranged. R10 is the first pixel value of the second row (for the red component), the G11 is the second pixel value (for the green component), and so on, and the second row of pixel values are arranged.

- **BayerGB10/BayerGB12**

When the pixel format is set to BayerGB10 or BayerGB12, the value of each pixel in the output image of the camera is 16 bits. According to the location difference, the three components of red, green and blue are respectively represented. The format in the memory is as follows:

G00	B01	G02	B03	G04	……
R10	G11	R12	G13	R14	……
……					

Each pixel is the same as BayerGB8, the difference is that each pixel is made up of two bytes, the first byte is the low 8 bits of the pixel value, and the second byte is the high 8 bits of the pixel value.

8.3.4. ROI

By setting the ROI of the image, the camera can transmit the specific region of the image, and the output region's parameters include OffsetX, OffsetY, width and height of the output image. The camera only reads the image data from the sensor's designated region to the memory, and transfer it to the host, and the other regions' image of the sensor will be discarded.

By default, the image ROI of the camera is the full resolution region of the sensor. By changing the OffsetX, OffsetY, width and height, the location and size of the image ROI can be changed. The OffsetX refers to the starting column of the ROI, and the OffsetY refers to the starting row of the ROI. Among them, the step of OffsetX and width vary from one camera to another, and the step of OffsetY and height is 2.

The coordinates of the ROI of the image are defined the 0^{th} raw and 0^{th} column as the origin of the upper left corner of the sensor. As shown in the figure, the OffsetX of the ROI is 4, the OffsetY is 4, the height is 8 and the width is 12.

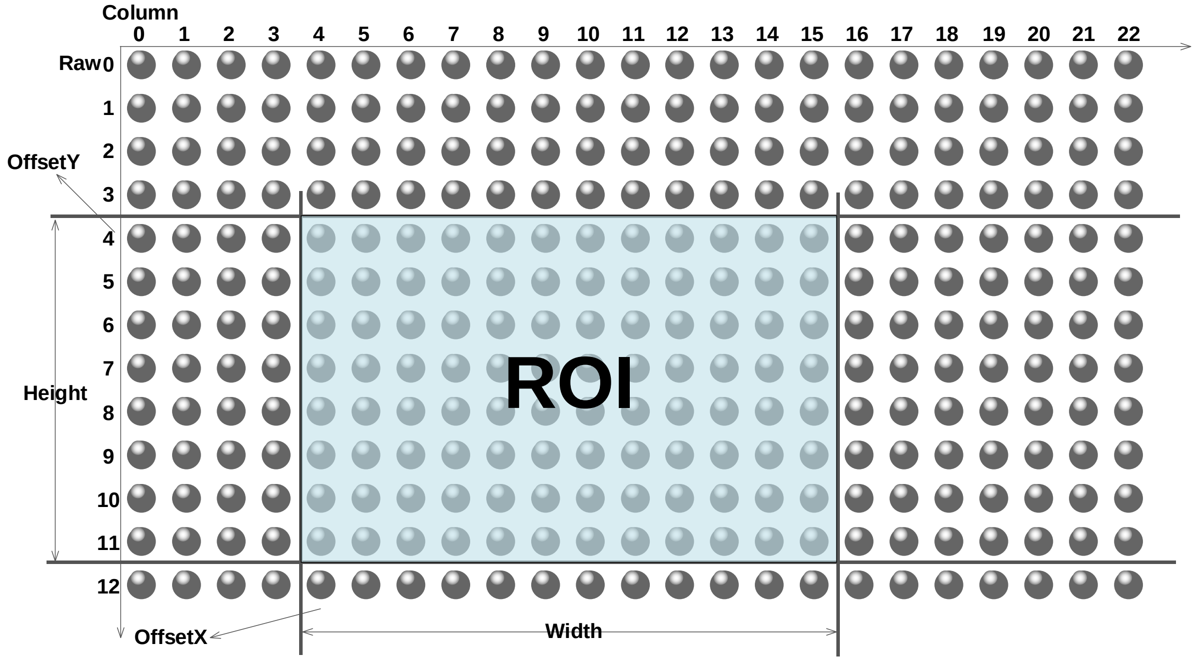


Figure 8-42 ROI

When reducing the height of the ROI, the maximum frame rate of the camera will be raised. Please refer to section 8.5.1 for specific effects on the acquisition frame rate.

8.3.5. Auto Exposure/Auto Gain

- **ROI Setting of Auto Exposure/ Auto Gain**

For Auto Exposure and Auto Gain, you can specify a portion of the sensor array and only the pixel data from the specified portion will be used for auto function control.

AAROI is defined by the following way:

AAROIOffsetX: The offset of the X axis direction.

AAROIOffsetY: The offset of the Y axis direction.

AAROIWidth: The width of ROI.

AAROIHeight: The height of ROI.

Offset is the offset value that relative to the upper left corner of the image. The step of AAROIOffsetX and AAROIWidth is 4. The step of AAROIOffsetY and AAROIHeight is 2. The setting of the AAROI depends on the size of the current image and cannot exceed the range of the current image. That is to say, assuming the Width and Height are parameters for users captured image, then the AAROI setting need to meet the condition 1:

$$AAROIWidth + AAROIOffsetX \leq Width$$

$$AAROIHeight + AAROIOffsetY \leq Height$$

If condition 1 is not met, the user cannot set the ROI.

The default value of ROI is the entire image, you can set the ROI according to your need. Where the minimum value of AAROIWidth can be set to 16, and the maximum value is equal to the current image width. The minimum value of AAROIHeight can be set to 16, and the maximum value is equal to the current image height, they are all need to meet the condition1.

For example: the current image width is 1024, the height is 1000, and then the ROI setting is:

AAROIOffsetX = 100

AAROIOffsetY = 50

AAROIWidth = 640

AAROIHeight = 480

The relative position of the ROI and the image is shown in Figure 8-43.

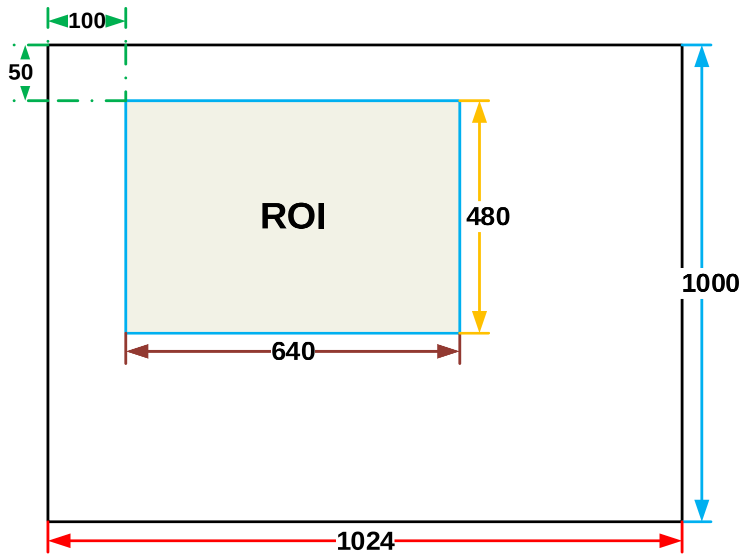


Figure 8-43 An example for the relative position between the ROI and the current image

- **Auto Gain**

The auto gain can adjust the camera's gain automatically, so that the average gray value in AAROI is achieved to the expected gray value. The auto gain can be controlled by "Once" and "Continuous" mode.

When using the "Once" mode, the camera adjusts the image data in the AAROI to the expected gray value once, then the camera will turn off the auto gain feature. When using the "Continuous" mode, the camera will continuous adjust the gain value according to the data of the AAROI, so that the data in the AAROI is kept near to the expected gray level.

The expected gray value is set by the user, and it is related to the data bit depth. For 8bit pixel data, the expected gray value range is 0-255, for 10bit pixel data, the expected gray value range is 0-1023, and for 12bit pixel data, the expected gray value range is 0-4095.

The camera adjusts the gain value within the range [minimum gain value, maximum gain value] which is set by the user.

The auto gain feature can be used with the auto exposure at the same time, when target grey is changed from dark to bright, the auto exposure adjust is prior to auto gain adjust. Vice versa, when target grey is changed from bright to dark, the auto gain adjust is prior to auto exposure adjust.

- **Auto Exposure**

The auto exposure can adjust the camera's exposure time automatically, so that the average gray value in AAROI can achieve to the expected gray value. The auto exposure can be controlled by "Once" and "Continuous" mode.

When using the "Once" mode, the camera adjusts the image data in the AAROI to the expected gray value once, then the camera will close the auto exposure feature. When using the "Continuous" mode, the camera will continuous adjusting the exposure time according to the data of the AAROI, so that the data in the AAROI is kept near to the expected gray level.

The expected gray value is set by the user and it is related to the data bit depth. For 8bit pixel data, the expected gray value range is 0-255, and for 12bit pixel data, the expected gray value range is 0-4095.

The camera adjusts the exposure time in the range [minimum exposure time, maximum exposure time] which is set by the user.

The auto exposure feature can be used with the auto gain at the same time, when target grey is changed from dark to bright, the auto exposure adjust is prior to auto gain adjust. Vice versa, when target grey is changed from bright to dark, the auto gain adjust is prior to auto exposure adjust.

8.3.6. Test Pattern

The MERCURY2 USB3 Vision camera supports three test images: gray gradient test image, static diagonal gray gradient test image, and moving diagonal gray gradient test image (ME2L cameras only support gray gradient test image). When the camera captures in RAW10 mode, the gray value of test image is: the pixel gray value in RAW8 mode multiplies by 4, as the output of pixel gray value in RAW10 mode.

The following three test images are illustrated in the RAW8 mode.

- GrayFrameRampMoving

In the gray gradient test image, all the pixels' gray values are the same in the frame. In the adjacent frame, the gray value of the next frame increases by 1 compared to the previous frame, until to 255, and then the next frame gray value returns to 0, and so on. A printscreen of a single frame is shown in Figure 8-44.

Figure 8-44 Gray gradient test image

- SlantLineMoving

In the moving diagonal gray gradient test image, the first pixel value of adjacent row in each frame increases by 1, until the last row. When the pixel gray value increases to 255, the next pixel gray value returns to 0. The first pixel gray value of adjacent column increases by 1, until the last column. When the pixel gray value increases to 255, the next pixel gray value returns to 0.

In the moving diagonal gray gradient test image, in the adjacent frame, the first pixel gray value of the next frame increases by 1 compared to the previous frame. So, in the dynamic image, the image is scrolling to the left. A printscreen of the moving diagonal gray gradient test image is shown in Figure 8-45:

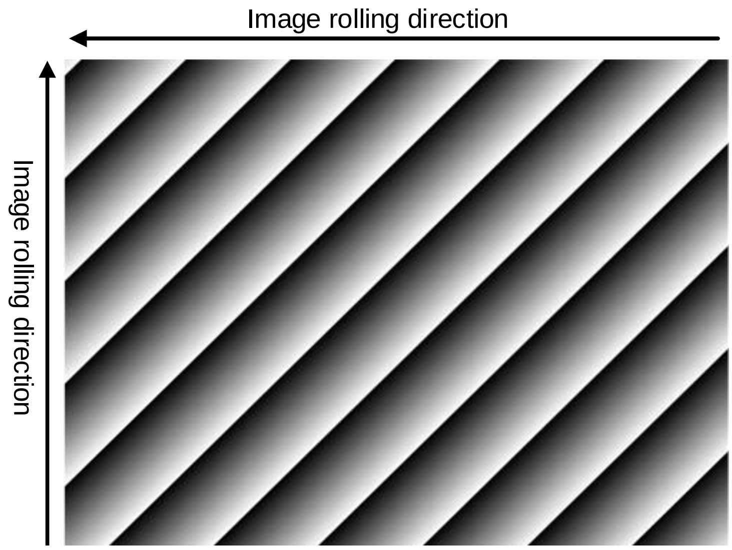


Figure 8-45 Moving diagonal gray gradient test image

- SlantLine

In the static diagonal gray gradient test image, the first pixel gray value is 0, the first pixel gray value of adjacent row increases by 1, until the last row. When the pixel gray value increases to 255, the next pixel gray value returns to 0. The first pixel gray value of adjacent column increases by 1, until the last column. When the pixel gray value increases to 255, the next pixel gray value returns to 0.

Compared to the moving diagonal gray gradient test image, in the adjacent image of the static diagonal gray gradient test image, the gray value in the same position remains unchanged. A printscreen of the static diagonal gray gradient test image is shown in Figure 8-46.

Figure 8-46 Static diagonal gray gradient test image

8.3.7. User Set Control

By setting various parameters of the camera, the camera can perform the best performance in different environments. There are two ways to set parameters: one is to modify the parameters manually, and the other is to load parameter set. In order to save the specific parameters of the users, avoiding to set the parameters every time when you open the camera, the MERCURY2 USB3 Vision camera provides a function to save the parameter set, which can easily save the parameters that the user use, including the control parameters that the camera needed. There three types of configuration parameters: the currently effective configuration parameters, the vendor default configuration parameters (Default), and the user configuration parameters (UserSet).

Three operations can be performed on the configuration parameters, including save parameters (UserSetSave), load parameters (UserSetLoad), and set the startup parameter set (UserSetDefault). The UserSetSave is to save the effective configuration parameters to the user configuration parameter set which is set by the user. The UserSetLoad is to load the vendor default configuration parameters (Default) or the user configuration parameters (UserSet) to the current effective configuration parameters. The UserSetDefault is refer to the user can specify a set of parameters which to be loaded into the effective configuration parameters automatically when the camera is reset or powered on. And the camera can work under this set of parameters. This set of parameters can be vendor default configuration parameters or user configuration parameters.

1) The type of configuration parameters

The type of configuration parameters includes: the current effective configuration parameters, vendor default configuration parameters, user configuration parameters.

The current effective configuration parameters: Refers to the current control parameters used by the camera. Using API function or Demo program to modify the current control parameters of the camera is to modify the effective configuration parameters. The effective parameters are stored in volatile memory of the camera, so when the camera is reset or powered on again, the effective configuration parameters will be lost.

The vendor default configuration parameters (Default): Before the camera leaves the factory, the camera manufacturer will test the camera to assess the camera's performance and optimize the configuration parameters of the camera. The vendor default configuration parameters are the camera configuration parameters optimized by the vendor in a particular environment, these parameters are stored in the non-volatile memory of the camera, so when the camera is reset or powered on again, the effective configuration parameters will not be lost, and these parameters cannot be modified.

The user configuration parameters (UserSet): The effective parameters are stored in volatile memory of the camera, so when the camera is reset or powered on again, the effective configuration parameters will be lost. You can store the effective configuration parameters to the user configuration parameters, the user configuration parameters are stored in the non-volatile memory of the camera, so when the camera is reset or powered on again, the user configuration parameters will not be lost. The MERCURY2 USB3 Vision camera can store a set of user configuration parameters.

2) The operation of configuration parameters

The operations for configuration parameters include the following three types: save parameters, load parameters and set the UserSetDefault.

Save parameters (UserSetSave): Save the current effective configuration parameters to the user configuration parameters. The storage steps are as follows:

1) Modify the camera's configuration parameters, until the camera runs to the user's requirements.

2) Use UserSetSelector to select UserSet0. Execute UserSetSave command.

The camera's configuration parameters which are saved in the user parameter set include:

- Gain
- ExposureTime
- PixelFormat
- OffsetX, OffsetY, ImageWidth, ImageHeight
- EventNotification
- TriggerMode, TriggerSource, TriggerPolarity, TriggerDelay
- TriggerFilterRaisingEdge, TriggerFilterFallingEdge
- LineMode, LineInverter, LineSource, UserOutputValue
- ChunkModeActive
- TestPattern
- ExpectedGrayValue
- ExposureAuto, AutoExposureTimeMax, AutoExposureTimeMin
- GainAuto, AutoGainMax, AutoGainMin

- AAROIOffsetX, AAROIOffsetY, AAROIWidth, AAROIHeight
- BalanceWhiteAuto, AWBLampHouse
- AWBROIOffsetX, AWBROIOffsetY, AWBROIWidth, AWBROIHeight
- BalanceRatio(R/G/B)
- LUT

Load parameters (UserSetLoad): Load the vendor default configuration parameters or the user configuration parameters into the effective configuration parameters. After this operation is performed, the effective configuration parameters will be covered by the loaded parameters which are selected by the user, and the new effective configuration parameters are generated. The operation steps are as follows:

1) Use UserSetSelector to select Default or UserSet0.

2) Execute UserSetLoad command to load the UserSet specified by UserSetSelector to the device and makes it active.

Change startup parameter set (UserSetDefault): The user can use UserSetDefault to select Default or UserSet0 as the UserSetDefault. When the camera is reset or powered on again, the parameters in the UserSetDefault will be loaded into the effective configuration parameters.

8.3.8. Device User ID

The MERCURY2 USB3 Vision camera provides programmable device user ID function, the user can set a unique identification for the camera, and can open and control the camera by the unique identification.

The user-defined name is a string which maximum length is 16 bytes, the user can set it by the following ways:

1) Set by the GalxyView, as shown in the Figure 8-47.

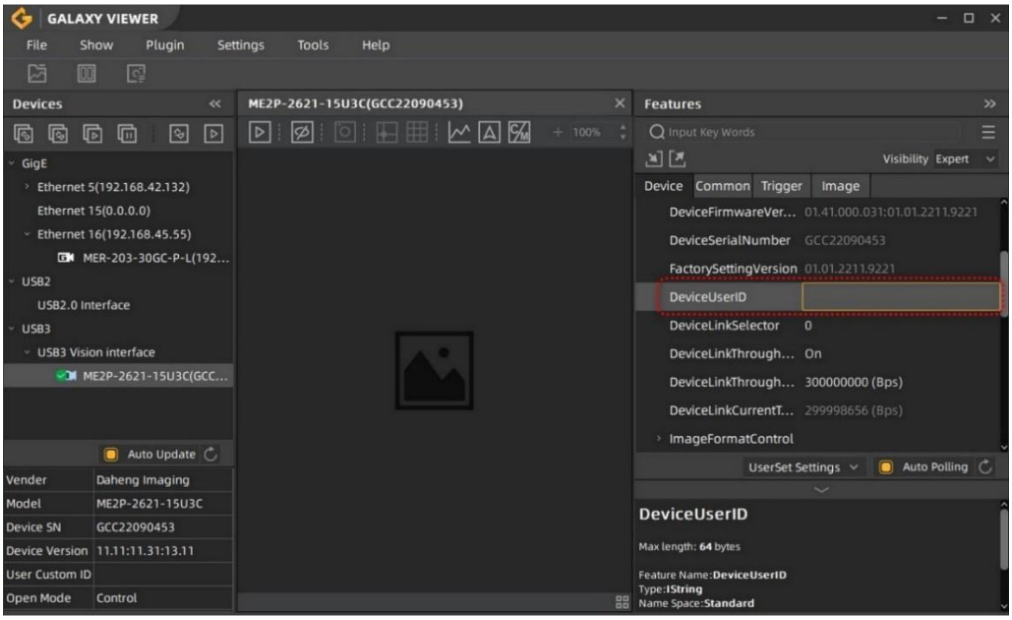


Figure 8-47 GalxyView software

2) Set by calling the software interface, for details please see the Programmer's Guide.

When using multi-cameras at the same time, it is necessary to ensure the uniqueness of the user-defined name of each camera, otherwise, an exception will occur when the camera is opened.

8.3.9. Timestamp

The timestamp feature counts the number of ticks generated by the camera's internal device clock. As soon as the camera is powered on, it starts generating and counting clock ticks. The counter is reset to 0 whenever the camera is powered off and on again. Some of the camera's features use timestamp values, such as event, frame information, and timestamps can be used to test the time spent on some of the camera's operations.

The unit of timestamp is ns.

8.3.10. Binning

The feature of Binning is to combine multiple pixels adjacent to each other in the sensor into a single value, and process the average value of multiple pixels or sum the multiple pixel values, which may increase the signal-to-noise ratio or the camera's response to light.

- **How Binning Works**

On color cameras, the camera combines (sums or averages) the pixel values of adjacent pixels of the same color:

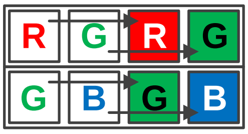


Figure 8-48 Horizontal color Binning by 2

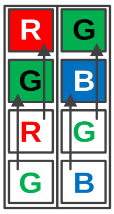


Figure 8-49 Vertical color Binning by 2

When the horizontal Binning factor and the vertical Binning factor are both set to 2, the camera combines the adjacent 4 sub-pixels of the same color according to the corresponding positions, and outputs the combined pixel values as one sub-pixel.

Figure 8-50 Horizontal and vertical color Binning by 2×2

On monochrome cameras, the camera combines (sums or averages) the pixel values of directly adjacent pixels:

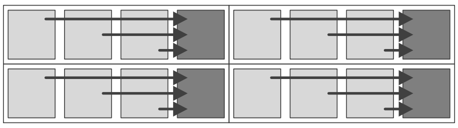


Figure 8-51 Horizontal mono Binning by 4

- **Binning Factors**

Two types of Binning are available: horizontal Binning and vertical Binning. You can set the Binning factor in one or two directions.

Horizontal Binning is the processing of pixels in adjacent rows.

Vertical Binning is the processing of pixels in adjacent columns.

Binning factor 1: Disable Binning.

Binning factor 2, 4: Indicate the number of rows or columns to be processed.

For example, the horizontal Binning factor 2 indicates that the Binning is enabled in the horizontal direction, and the pixels of two adjacent rows are processed.

- **Binning Modes**

The Binning mode defines how pixels are combined when Binning is enabled. Two types of the Binning mode are available: Sum and Average.

Sum: The values of the affected pixels are summed and then output as one pixel. This improves the signal-to-noise ratio, but also increases the camera's response to light.

Average: The values of the affected pixels are averaged. This greatly improves the signal-to-noise ratio without affecting the camera's response to light.

- **Considerations when Using Binning**

1) Effect on ROI settings

When Binning is used, the value of the current ROI of the image, the maximum ROI of the image, the auto function ROI, and the auto white balance ROI will change. The changed value is the original value (the value before the setting) divided by the Binning factor.

For example, assume that you are using a camera with a 1200 x 960 sensor. Horizontal Binning by 2 and vertical Binning by 2 are enabled. In this case, the maximum ROI width is 600 and the maximum ROI height is 480.

2) Increased response to light

Using Binning with the Binning mode set to **Sum** can significantly increase the camera's response to light. When pixel values are summed, the acquired images may look overexposed. If this is the case, you can reduce the lens aperture, the intensity of your illumination, the camera's exposure time setting, or the camera's gain setting.

3) Possible image distortion

Objects will only appear undistorted in the image if the numbers of binned rows and columns are equal. With all other combinations, objects will appear distorted. For example, if you combine vertical Binning by 2 with horizontal Binning by 4, the target objects will appear squashed.

4) Mutually exclusive with Decimation

Binning and Decimation cannot be used simultaneously in the same direction. When the horizontal Binning value is set to a value other than 1, the horizontal Decimation feature cannot be used. When the vertical Binning value is set to a value other than 1, the vertical Decimation feature cannot be used.

8.3.11. Decimation

The Decimation can reduce the number of sensor pixel columns or rows that are transmitted by the camera, reducing the amount of data that needs to be transmitted and reducing bandwidth usage.

- **How Vertical Decimation Works**

On mono cameras, if you specify a vertical Decimation factor of n, the camera transmits only every n^{th} row. For example, when you specify a vertical Decimation factor of 2, the camera skips row 1, transmits row 2, skips row 3, and so on.

On color cameras, if you specify a vertical Decimation factor of n, the camera transmits only every n^{th} pair of rows. For example, when you specify a vertical Decimation factor of 2, the camera skips rows 1 and 2, transmits rows 3 and 4, skips rows 5 and 6, and so on.

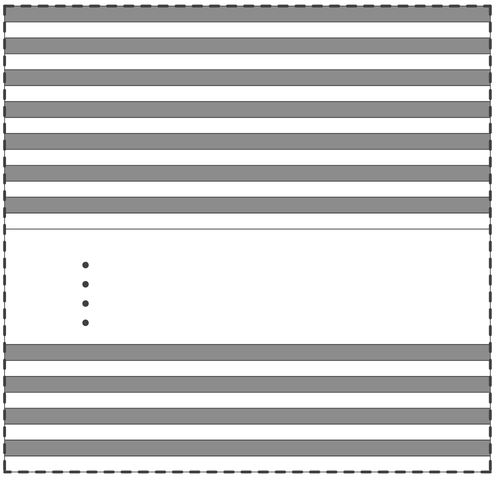


Figure 8-52 Mono camera vertical Decimation

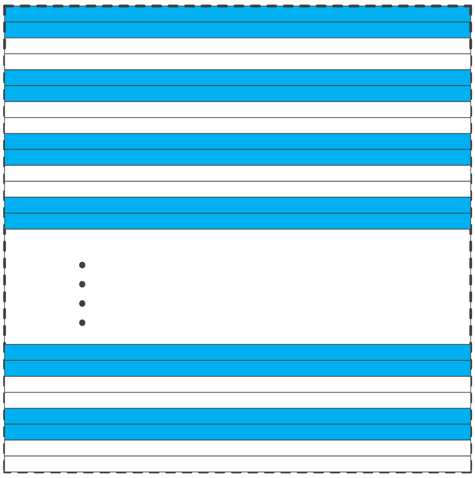


Figure 8-53 Color camera vertical Decimation

As a result, the image height is reduced. For example, enabling vertical Decimation by 2 halves the image height. The camera automatically adjusts the image ROI settings.

Vertical Decimation significantly increases the camera's frame rate. For details, please refer to the section 9.4 MERCURY2 USB3 Vision Frame Rate Calculation Tool.

- **How Horizontal Decimation Works**

On mono cameras, if you specify a horizontal Decimation factor of n, the camera transmits only every n^{th} column. For example, if specify set a horizontal Decimation factor of 2, the camera skips column 1, transmits column 2, skips column 3, and so on.

On color cameras, if you specify a horizontal Decimation factor of n, the camera transmits only every n^{th} pair of columns. For example, if you specify a horizontal Decimation factor of 2, the camera skips columns 1 and 2, transmits columns 3 and 4, skips columns 5 and 6, and so on.

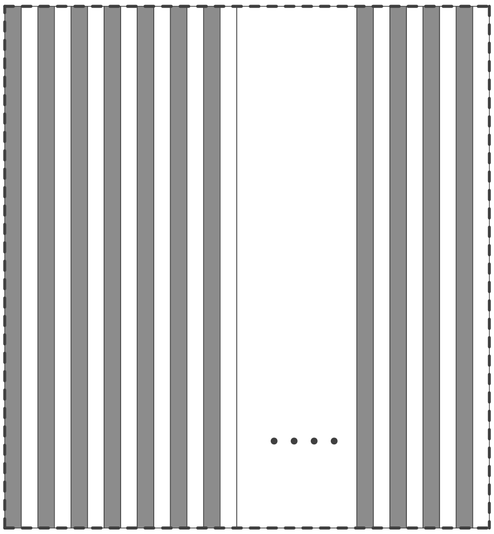


Figure 8-54 Mono camera horizontal Decimation

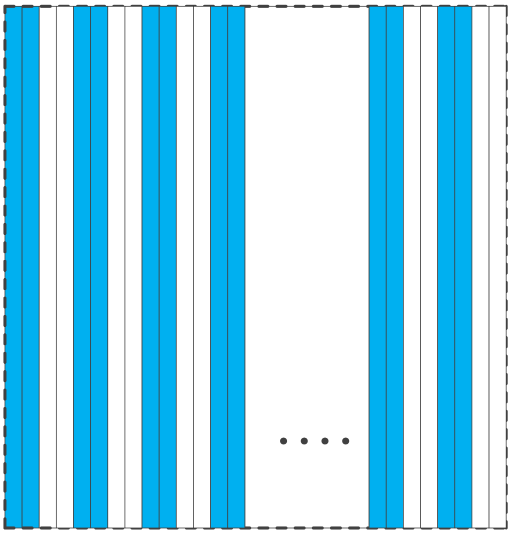


Figure 8-55 Color camera horizontal Decimation

As a result, the image width is reduced. For example, enabling horizontal Decimation by 2 halves the image width. The camera automatically adjusts the image ROI settings.

Horizontal Decimation does not (or only to a very small extent) increase the camera's frame rate.

- **Configuring Decimation**

To configure vertical Decimation, enter a value for the DecimationVertical parameter. To configure horizontal Decimation, enter a value for the DecimationHorizontal parameter.

The value of the parameters defines the Decimation factor. Depending on your camera model, the following values are available:

1: Disable Decimation.

2: Enable Decimation.

- **Considerations When Using Decimation**

1) Effect on ROI settings

When you are using Decimation, the settings for your image ROI refer to the resulting number of rows and columns. Taking MER2-502-79U3M/C(-L) as an example, the camera's default resolution is 2448×2048.

When horizontal Decimation by 4 and vertical Decimation by 4 are enabled, the maximum ROI width would be 612 and the maximum ROI height would be 512.

2) Reduced resolution

Using Decimation effectively reduces the resolution of the camera's imaging sensor. Taking MER2-502-79U3M/C(-L) as an example, the camera's default resolution is 2448×2048. When horizontal Decimation by 4 and vertical Decimation by 4 are enabled, the effective resolution of the sensor is reduced to 612×512.

3) Possible image distortion

The displayed image will not be distorted if the vertical and horizontal Decimation factors are equal. When only horizontal Decimation or vertical Decimation is used, the displayed image will be reduced in width or height.

4) Mutually exclusive with Binning

Decimation and Binning cannot be used simultaneously in the same direction. When the horizontal Decimation value is set to a value other than 1, the horizontal Binning feature cannot be used. When the vertical Decimation value is set to a value other than 1, the vertical Binning feature cannot be used.

On some camera models, user can select to perform Sensor or FPGA decimation. The difference is that Sensor decimation may increase the camera's frame rate.

8.3.12. Reverse X and Reverse Y

The Reverse X and Reverse Y features can mirror acquired images horizontally, vertically, or both.

- **Enabling Reverse X**

To enable Reverse X, set the **ReverseX** parameter to **true**. The camera mirrors the image horizontally.

Figure 8-56 The original image

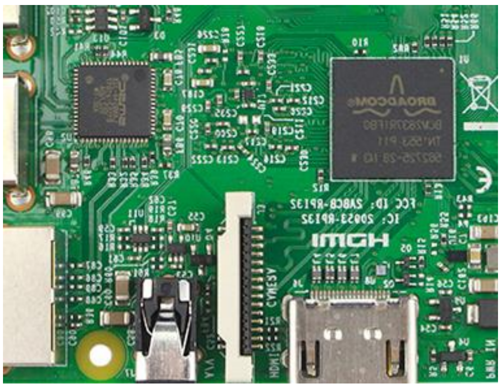


Figure 8-57 Reverse X enabled

- **Enabling Reverse Y**

To enable Reverse Y, set the **ReverseY** parameter to **true**. The camera mirrors the image vertically.

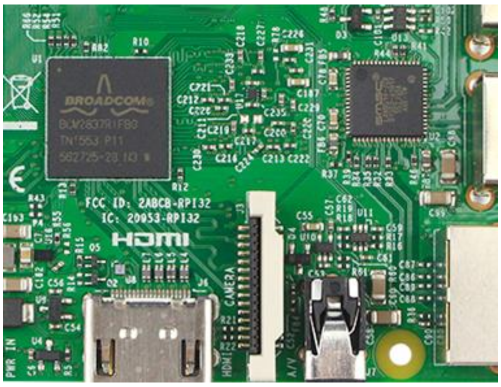


Figure 8-58 The original image

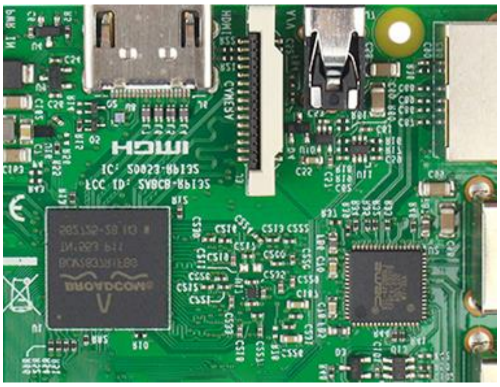


Figure 8-59 Reverse Y enabled

- **Enabling Reverse X and Y**

To enable Reverse X and Y, set the **ReverseX** and **ReverseY** parameters to **true**. The camera mirrors the image horizontally and vertically.

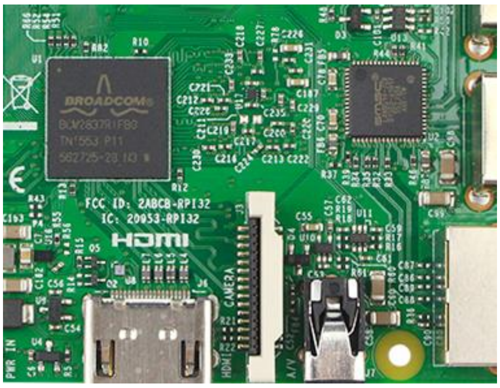


Figure 8-60 The original image

Figure 8-61 Reverse X and Y enabled

- **Using Image ROI with Reverse X or Reverse Y**

If you have specified an image ROI while using Reverse X or Reverse Y, you must bear in mind that the position of the ROI relative to the sensor remains the same. Therefore, the camera acquires different portions of the image depending on whether the Reverse X or the Reverse Y feature are enabled:

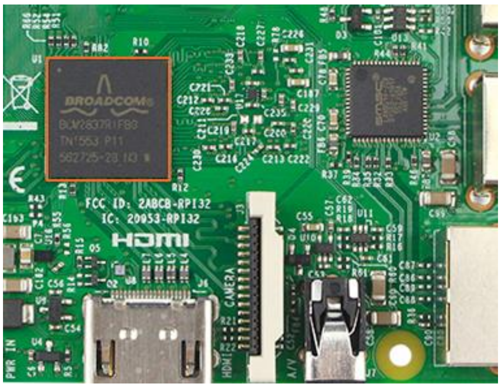


Figure 8-62 The original image

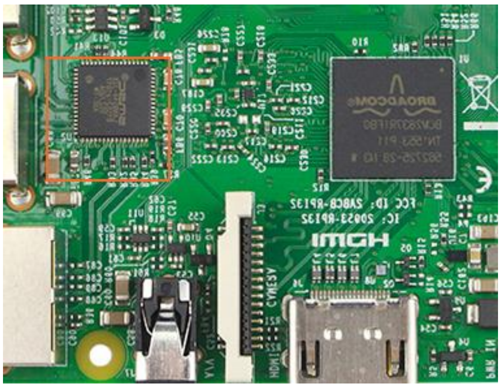


Figure 8-63 Reverse X enabled

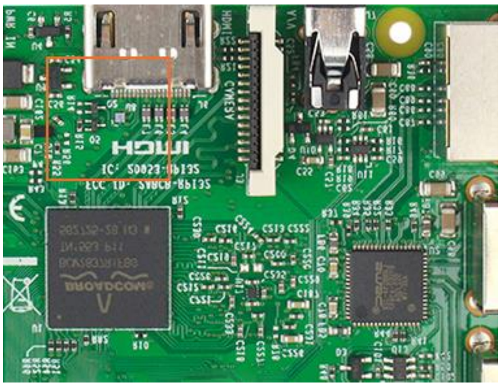


Figure 8-64 Reverse Y enabled

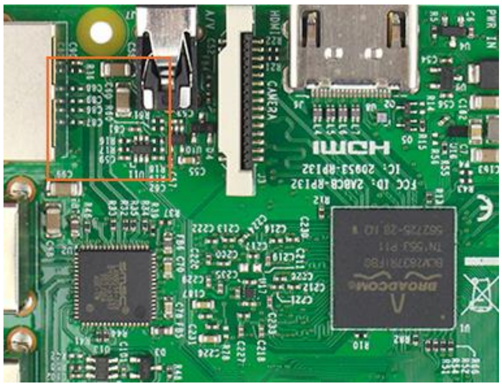


Figure 8-65 Reverse X and Y enabled

- **Pixel Format Alignment**

When camera is using the reverse feature, the alignment of the Bayer format of some cameras does not change, and the others is change.

Camera models and changes in the alignment of the Bayer format after using the reverse feature are as follows:

Model	Reverse X and Reverse Y	Bayer format
ME2L-042-121U3C(-L)	Disable Reverse X and Reverse Y	BayerRG
	Enable Reverse X and disable Reverse Y	BayerGR
	Disable Reverse X and enable Reverse Y	BayerGB
	Enable Reverse X and Reverse Y	BayerBG
ME2L-161-61U3C(-L)	Disable Reverse X and Reverse Y	BayerRG
	Enable Reverse X and disable Reverse Y	BayerGR
	Disable Reverse X and enable Reverse Y	BayerGB
	Enable Reverse X and Reverse Y	BayerBG
ME2L-203-76U3C(-L)	Disable Reverse X and Reverse Y	BayerRG
	Enable Reverse X and disable Reverse Y	BayerRG
	Disable Reverse X and enable Reverse Y	BayerGB
	Enable Reverse X and Reverse Y	BayerGB
ME2L-204-76U3C(-L)-F02	Disable Reverse X and Reverse Y	BayerRG
	Enable Reverse X and disable Reverse Y	BayerRG
	Disable Reverse X and enable Reverse Y	BayerGB
	Enable Reverse X and Reverse Y	BayerGB

8.3.13. Digital Shift

The Digital Shift can multiply the pixel values by 2^n of the images.

This increases the brightness of the image. If your camera doesn't support the digital shift feature, you can use the Gain feature to achieve a similar effect.

- **How Digital Shift Works**

Configuring a digital shift factor of n results in a logical left shift by n on all pixel values. This has the effect of multiplying all pixel values by 2^n.

If the resulting pixel value is greater than the maximum value possible for the current pixel format (e.g., 255 for an 8-bit pixel format, 1023 for a 10-bit pixel format, and 4095 for a 12-bit pixel format), the value is set to the maximum value.

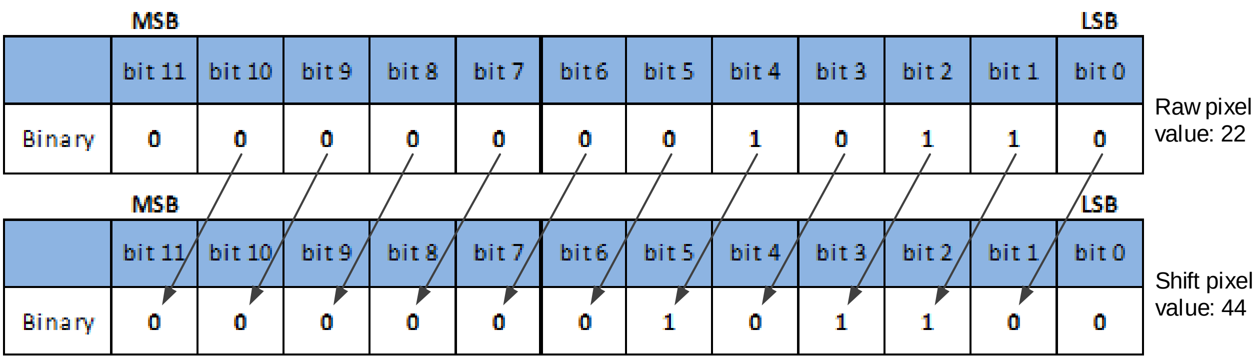
- **Configuring Digital Shift**

To configure the digital shift factor, enter the expected value for the **DigitalShift** parameter.

By default, the parameter is set to 0, i.e., digital shift is disabled. When the **DigitalShift** parameter is set to 1, the camera will shift the pixel value to the left by 1 bit. When the **DigitalShift** parameter is set to 2, the camera will shift the pixel value to the left by 2 bits.

- **Considerations When Using Digital Shift**

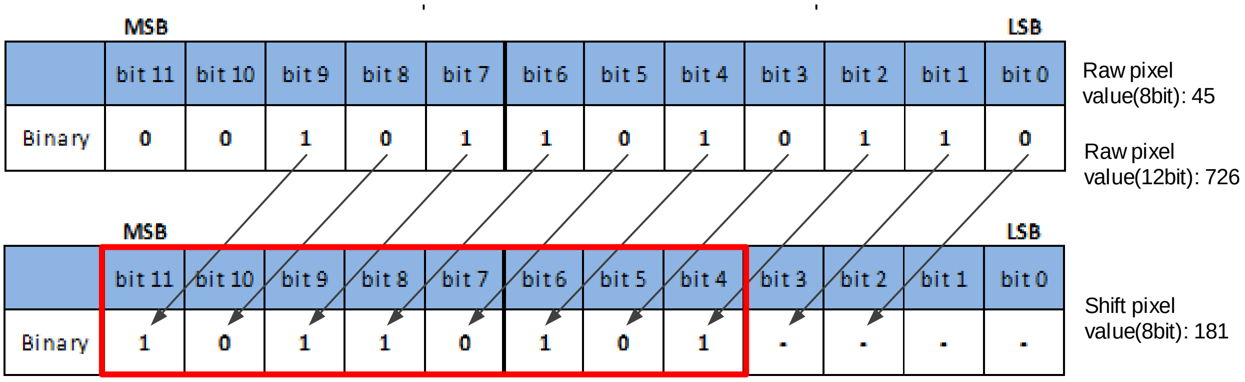
Example 1: Digital Shift by 1, 12-bit Image Data



The least significant bit in each 12-bit image data is set to 0.

Example 2: Digital Shift by 2, 8-bit Image Data

Assume that your camera has a maximum pixel bit depth of 12-bit, but is currently using an 8-bit pixel format. In this case, the camera first performs the digital shift calculation on the 12-bit image data. Then, the camera transmits the 8 most significant bits.



Example 3: Digital Shift by 1, 12-bit Image Data, High Value

Assume that your camera is using a 12-bit pixel format. Also assume that one of your original pixel values is 2839.

	MSB bit 11	bit 10	bit 9	bit 8	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	LSB bit 0	
Binary	1	0	1	1	0	0	0	1	0	1	1	1	Raw pixel value: 2839

	MSB bit 11	bit 10	bit 9	bit 8	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	LSB bit 0	
Binary	1	1	1	1	1	1	1	1	1	1	1	1	Shift pixel value: 4095

If you apply digital shift by 1 to this pixel value, the resulting value is greater than the maximum possible value for 12-bit pixel formats. In this case, the value is set to the maximum value, i.e., all bits are set to 1.

8.3.14. Acquisition Status

The Acquisition Status feature can determine whether the camera is waiting for trigger signals. This is useful if you want to optimize triggered image acquisition and avoid over triggering.

To determine if the camera is currently waiting for trigger signals.

a) Set the **AcquisitionStatusSelector** parameter to the expected trigger type. Two trigger types are available: **FrameTriggerWait** and **AcquisitionTriggerWait**. For example, if you want to determine if the camera is waiting for **FrameStartTrigger** signals, set the **AcquisitionStatusSelector** to **FrameTriggerWait**. If you want to determine if the camera is waiting for **FrameBurstStartTrigger** signals, set the **AcquisitionStatusSelector** to **AcquisitionTriggerWait**.

b) If the **AcquisitionStatus** parameter is **true**, the camera is waiting for a trigger signal of the trigger type selected. If the **AcquisitionStatus** parameter is **false**, the camera is busy.

8.3.15. Black Level and Auto Black Level

8.3.15.1. Black Level

The Black Level can change the overall brightness of an image by changing the gray values of the pixels by a specified amount. The lower the black level, the darker the corresponding image, the higher the black level, the brighter the corresponding image.

Currently, only ME2S-560-70U3C supports the adjustment of the black level value by channel, and the black level value of the channel can be changed by switching to the corresponding channel. The application range of the black level value of other cameras can only be selected as all pixels, and pixel selection is not supported.

8.3.15.2. Auto Black Level

The dark current is greatly affected by the ambient temperature and individual differences are greater for high resolution camera models. The Auto Black Level function can correct the inconsistent performance of the camera in dark field caused by the difference of temperature and sensor. When the Auto Black Level is enabled, the black level value is automatically adjusted to ensure that the average gray value of the dark field is about 0.5 in the highest bit depth image. The default mode is "Off". If it is "Continuous" mode, the black level is adjustment continuously. If it is "Once" mode, the auto black level mode will automatically change to Off after once adjustment. If it is "Off" mode, the auto black level is disabled.

Auto Black Level does not support the adjustment of the black level value by channel.

8.3.16. Remove Parameter Limits

The range of camera parameters is usually limited, and these factory limits are designed to ensure the best camera performance and high image quality. However, for certain use cases, you may want to specify parameter values outside of the factory limits. You can use the remove parameter limits feature to expand the parameter range. The features of the extended range supported by different cameras may be different and the range may be different, as shown in Table 8-4.

Model	Features	Set the switch to off	Set the switch to on
MER2-041-528U3M/C(-L)	Exposure	20~1000000	20~15000000
	Auto Exposure	20~1000000	20~15000000
	Gain	0~24	0~48
	Auto Gain	0~24	0~48
	Black Level	0~255 (BPP8) 0~1023 (BPP10) 0~4095 (BPP12)	0~255 (BPP8) 0~1023 (BPP10) 0~4095 (BPP12)
	Sharpness	0~3	0~63
	White Balance component	0~15.996	0~63.996
	Auto White Balance	0~15.996	0~63.996
MER2-060-642U3M(-L)	Exposure	7~1000000	7~15000000
	Auto Exposure	7~1000000	7~15000000
	Gain	0~16	0~24
	Auto Gain	0~16	0~24
	Black Level	0~1023	0~1023
	Sharpness	0~3	0~63
MER2-135-150U3M/C(-L)	Exposure	8~1000000	8~15000000
	Auto Exposure	8~1000000	8~15000000
	Gain	0~16	0~20

	Auto Gain	0~16	0~20
	Black Level	0~1023	0~1023
	Sharpness	0~3	0~63
	White Balance component	0~15.996	0~63.996
	Auto White Balance	0~15.996	0~63.996
MER2-135-208U3M/C(-L)	Exposure	8~1000000	8~15000000
	Auto Exposure	8~1000000	8~15000000
	Gain	0~16	0~20
	Auto Gain	0~16	0~20
	Black Level	0~1023	0~1023
	White Balance component	0~15.996	0~63.996
	Auto White Balance	0~15.996	0~63.996
MER2-160-227U3M/C(-L)	Exposure	20~1000000	20~15000000
	Auto Exposure	20~1000000	20~15000000
	Gain	0~24	0~48
	Auto Gain	0~24	0~48
	Black Level	0~255	0~255
	Sharpness	0~3	0~63
	White Balance component	0~15.996	0~63.996
	Auto White Balance	0~15.996	0~63.996
MER2-230-168U3M/C(-L)	Exposure	20~1000000	20~15000000
	Auto Exposure	20~1000000	20~15000000
	Gain	0~24	0~48
	Auto Gain	0~24	0~48
	Black Level	0~511	0~511
	Sharpness	0~3	0~63
	White Balance component	0~15.996	0~63.996
	Auto White Balance	0~15.996	0~63.996

MER2-231-41U3M/C(-L)	Exposure	20~1000000	20~15000000
	Auto Exposure	20~1000000	20~15000000
	Gain	0~24	0~48
	Auto Gain	0~24	0~48
	Black Level	0~4095	0~4095
	Sharpness	0~3	0~63
	White Balance component	0~15.996	0~63.996
	Auto White Balance	0~15.996	0~63.996
MER2-240-159U3M/C(-L)	Exposure	7~1000000	7~15000000
	Auto Exposure	7~1000000	7~15000000
	Gain	0~16	0~24
	Auto Gain	0~16	0~24
	Black Level	0~4095	0~4095
	Sharpness	0~3	0~63
	White Balance component	0~15.996	0~63.996
	Auto White Balance	0~15.996	0~63.996
MER2-280-139U3M/C(-L)	Exposure	9~1000000	9~15000000
	Auto Exposure	9~1000000	9~15000000
	Gain	0~24	0~48
	Auto Gain	0~24	0~48
	Black Level	0~1023 (BPP10) 0~4095 (BPP12)	0~1023 (BPP10) 0~4095 (BPP12)
	Sharpness	0~3	0~63
	White Balance component	0~15.996	0~63.996
	Auto White Balance	0~15.996	0~63.996
MER2-301-125U3M/C(-L)	Exposure	20~1000000	20~15000000
	Auto Exposure	20~1000000	20~15000000
	Gain	0~24	0~48
	Auto Gain	0~24	0~48
	Black Level	0~1023	0~1023
	Sharpness	0~3	0~63
	White Balance component	0~15.996	0~63.996
	Auto White Balance	0~15.996	0~63.996

MER2-302-56U3M/C(-L)	Exposure	20~1000000	20~15000000
	Auto Exposure	20~1000000	20~15000000
	Gain	0~24	0~48
	Auto Gain	0~24	0~48
	Black Level	0~4084	0~4084
	Sharpness	0~3	0~63
	White Balance component	0~15.996	0~63.996
	Auto White Balance	0~15.996	0~63.996
MER2-303-107U3M/C(-L)	Exposure	20~1000000	20~15000000
	Auto Exposure	20~1000000	20~15000000
	Gain	0~24	0~48
	Auto Gain	0~24	0~48
	Black Level	0~4095	0~4095
	Sharpness	0~3	0~63
	White Balance component	0~15.996	0~63.996
	Auto White Balance	0~15.996	0~63.996
MER2-304-56U3M/C(-L)	Exposure	20~1000000	20~15000000
	Auto Exposure	20~1000000	20~15000000
	Gain	0~24	0~48
	Auto Gain	0~24	0~48
	Black Level	0~4095	0~4095
	Sharpness	0~3	0~63
	White Balance component	0~15.996	0~63.996
	Auto White Balance	0~15.996	0~63.996
MER2-501-79U3M/C(-L)	Exposure	20~1000000	20~15000000
	Auto Exposure	20~1000000	20~15000000
	Gain	0~24	0~48
	Auto Gain	0~24	0~48
	Black Level	0~4095	0~4095
	Sharpness	0~3	0~63
	White Balance component	0~15.996	0~63.996
	Auto White Balance	0~15.996	0~63.996

MER2-502-79U3M/C(-L)	Exposure	20~1000000	20~15000000
	Auto Exposure	20~1000000	20~15000000
	Gain	0~24	0~48
	Auto Gain	0~24	0~48
	Black Level	0~1023	0~1023
	Sharpness	0~3	0~63
	White Balance component	0~15.996	0~63.996
	Auto White Balance	0~15.996	0~63.996
MER2-502-79U3M POL	Exposure	20~1000000	20~15000000
	Auto Exposure	20~1000000	20~15000000
	Gain	0~24	0~48
	Auto Gain	0~24	0~48
	Black Level	0~1023	0~1023
	Sharpness	0~3	0~63
MER2-503-36U3M/C(-L)	Exposure	20~1000000	20~15000000
	Auto Exposure	20~1000000	20~15000000
	Gain	0~24	0~48
	Auto Gain	0~24	0~48
	Black Level	0~4095	0~4095
	Sharpness	0~3	0~63
	White Balance component	0~15.996	0~63.996
	Auto White Balance	0~15.996	0~63.996
MER2-503-36U3M POL	Exposure	20~1000000	20~15000000
	Auto Exposure	20~1000000	20~15000000
	Gain	0~24	0~48
	Auto Gain	0~24	0~48
	Black Level	0~4095	0~4095
	Sharpness	0~3	0~63

MER2-510-36U3M/C(-L)	Exposure	20~1000000	20~15000000
	Auto Exposure	20~1000000	20~15000000
	Gain	0~24	0~48
	Auto Gain	0~24	0~48
	Black Level	0~4095	0~4095
	Sharpness	0~3	0~63
	White Balance component	0~15.996	0~63.996
	Auto White Balance	0~15.996	0~63.996
MER2-630-60U3M/C(-L/-W90/-W90-S90)	Exposure	8~1000000	8~15000000
	Auto Exposure	8~1000000	8~15000000
	Gain	0~24	0~27
	Auto Gain	0~24	0~27
	Black Level	0~1023	0~1023
	Sharpness	0~3	0~63
	White Balance component	0~15.996	0~63.996
	Auto White Balance	0~15.996	0~63.996
MER2-1220-32U3M/C(-L/-W90/-W90-S90)	Exposure	10~1000000	10~15000000
	Auto Exposure	10~1000000	10~15000000
	Gain	0~24	0~27
	Auto Gain	0~24	0~27
	Black Level	0~255	0~255
	Sharpness	0~3	0~63
	White Balance component	0~15.996	0~63.996
	Auto White Balance	0~15.996	0~63.996
MER2-2000-19U3M/C(-L/-W90/-W90-S90)	Exposure	12~1000000	12~15000000
	Auto Exposure	12~1000000	12~15000000
	Gain	0~24	0~27
	Auto Gain	0~24	0~27
	Black Level	0~255	0~255
	Sharpness	0~3	0~63
	White Balance component	0~15.996	0~63.996
	Auto White Balance	0~15.996	0~63.996

MER2-2002-20U3M/C(-L)	Exposure	26~1000000	26~15000000
	Auto Exposure	26~1000000	26~15000000
	Gain	0~24	0~50.625
	Auto Gain	0~24	0~50.625
	Black Level	0~1023	0~1023
	Sharpness	0~3	0~63
	White Balance component	0~15.996	0~63.996
	Auto White Balance	0~15.996	0~63.996
MER2-041-608U3M/C(-L)-HS	Exposure	20~1000000	20~15000000
	Auto Exposure	20~1000000	20~15000000
	Gain	0~24	0~48
	Auto Gain	0~24	0~48
	Black Level	0~255 (BPP8) 0~1023 (BPP10) 0~4095 (BPP12)	0~255 (BPP8) 0~1023 (BPP10) 0~4095 (BPP12)
	Sharpness	0~3	0~63
	White Balance component	0~15.996	0~63.996
	Auto White Balance	0~15.996	0~63.996
MER2-160-249U3M/C(-L)-HS	Exposure	20~1000000	20~15000000
	Auto Exposure	20~1000000	20~15000000
	Gain	0~24	0~48
	Auto Gain	0~24	0~48
	Black Level	0~255	0~255
	Sharpness	0~3	0~63
	White Balance component	0~15.996	0~63.996
	Auto White Balance	0~15.996	0~63.996
MER2-301-125U3M/C(-L)-HS	Exposure	20~1000000	20~15000000
	Auto Exposure	20~1000000	20~15000000
	Gain	0~24	0~48
	Auto Gain	0~24	0~48
	Black Level	0~1023	0~1023
	Sharpness	0~3	0~63
	White Balance component	0~15.996	0~63.996
	Auto White Balance	0~15.996	0~63.996

MER2-502-79U3M/C(-L)-HS	Exposure	20~1000000	20~15000000
	Auto Exposure	20~1000000	20~15000000
	Gain	0~24	0~48
	Auto Gain	0~24	0~48
	Black Level	0~1023	0~1023
	Sharpness	0~3	0~63
	White Balance component	0~15.996	0~63.996
	Auto White Balance	0~15.996	0~63.996
MER2-502-79U3M-HS POL	Exposure	20~1000000	20~15000000
	Auto Exposure	20~1000000	20~15000000
	Gain	0~24	0~48
	Auto Gain	0~24	0~48
	Black Level	0~1023	0~1023
	Sharpness	0~3	0~63
MER2-041-608U3M/C(-L)-HS-6P	Exposure	20~1000000	20~15000000
	Auto Exposure	20~1000000	20~15000000
	Gain	0~24	0~48
	Auto Gain	0~24	0~48
	Black Level	0~255 (BPP8) 0~1023 (BPP10) 0~4095 (BPP12)	0~255 (BPP8) 0~1023 (BPP10) 0~4095 (BPP12)
	Sharpness	0~3	0~63
	White Balance component	0~15.996	0~63.996
	Auto White Balance	0~15.996	0~63.996
MER2-160-249U3M/C(-L)-HS-6P	Exposure	20~1000000	20~15000000
	Auto Exposure	20~1000000	20~15000000
	Gain	0~24	0~48
	Auto Gain	0~24	0~48
	Black Level	0~255	0~255
	Sharpness	0~3	0~63
	White Balance component	0~15.996	0~63.996
	Auto White Balance	0~15.996	0~63.996

ME2S-560-70U3M/C	Exposure	11~1000000	11~15000000
	Auto Exposure	11~1000000	11~15000000
	Gain	0~16	0~24
	Auto Gain	0~16	0~24
	Black Level	-2047~2047	-2047~2047
	Sharpness	0~3	0~63
	White Balance component	0~15.996	0~63.996
	Auto White Balance	0~15.996	0~63.996
ME2S-1260-28U3M/C	Exposure	162~1000000	162~15000000
	Auto Exposure	162~1000000	162~15000000
	Gain	0~24	0~24
	Auto Gain	0~24	0~24
	Black Level	-4095~4095	-4095~4095
	Sharpness	0~3	0~63
	White Balance component	0~15.996	0~63.996
	Auto White Balance	0~15.996	0~63.996
ME2S-1610-24U3M/C	Exposure	3~1000000	3~15000000
	Auto Exposure	3~1000000	3~15000000
	Gain	0~24	0~48 (Mono) 0~46.5 (Color)
	Auto Gain	0~24	0~48 (Mono) 0~46.5 (Color)
	Black Level	0~1023 (BPP10) 0~4095 (BPP12)	0~1023 (BPP10) 0~4095 (BPP12)
	Sharpness	0~3	0~63
	White Balance component	0~15.996	0~63.996
	Auto White Balance	0~15.996	0~63.996
ME2S-2020-19U3M/C	Exposure	3~1000000	3~15000000
	Auto Exposure	3~1000000	3~15000000
	Gain	0~24	0~48 (Mono) 0~46.5 (Color)
	Auto Gain	0~24	0~48 (Mono) 0~46.5 (Color)

	Black Level	0~4095 (BPP8) 0~1023 (BPP10) 0~4095 (BPP12)	0~4095 (BPP8) 0~1023 (BPP10) 0~4095 (BPP12)
	Sharpness	0~3	0~63
	White Balance component	0~15.996	0~63.996
	Auto White Balance	0~15.996	0~63.996
ME2S-2440-16U3M/C	Exposure	3~1000000	3~15000000
	Auto Exposure	3~1000000	3~15000000
	Gain	0~24	0~48
	Auto Gain	0~24	0~48
	Black Level	0~1023 (BPP10) 0~4095 (BPP12)	0~1023 (BPP10) 0~4095 (BPP12)
	Sharpness	0~3	0~63
	White Balance component	0~15.996	0~63.996
	Auto White Balance	0~15.996	0~63.996
ME2S-2560-15U3M	Exposure	3~1000000	3~15000000
	Auto Exposure	3~1000000	3~15000000
	Gain	0~24	0~48
	Auto Gain	0~24	0~48
	Black Level	0~1023 (BPP10) 0~4095 (BPP12)	0~1023 (BPP10) 0~4095 (BPP12)
	Sharpness	0~3	0~63
ME2S-138-136U3M-SWIR	Exposure	13~1000000	13~15000000
	Auto Exposure	13~1000000	13~15000000
	Gain	0~16	0~24
	Auto Gain	0~16	0~24
	Sharpness	0~3	0~63
ME2S-138-232U3M-SWIR	Exposure	13~1000000	13~15000000
	Auto Exposure	13~1000000	13~15000000
	Gain	0~16	0~24
	Auto Gain	0~16	0~24
	Sharpness	0~3	0~63

ME2P-170-210U3M/C	Exposure	9~1000000	9~15000000
	Auto Exposure	9~1000000	9~15000000
	Gain	0~24	0~48
	Auto Gain	0~24	0~48
	Black Level	0~1023 (BPP10) 0~4095 (BPP12)	0~1023 (BPP10) 0~4095 (BPP12)
	Sharpness	0~3	0~63
	White Balance component	0~15.996	0~63.996
	Auto White Balance	0~15.996	0~63.996
ME2P-530-72U3M NIR ME2P-530-72U3C	Exposure	20~100000	20~1000000
	Auto Exposure	20~100000	20~1000000
	Gain	0~16	0~16
	Auto Gain	0~16	0~16
	Black Level	0~255	0~255
	Sharpness	0~3	0~63
	White Balance component	0~15.996	0~63.996
	Auto White Balance	0~15.996	0~63.996
ME2P-560-36U3M/C	Exposure	11~1000000	11~15000000
	Auto Exposure	11~1000000	11~15000000
	Gain	0~16	0~24
	Auto Gain	0~16	0~24
	Black Level	-256~2047	-256~2047
	Sharpness	0~3	0~63
	White Balance component	0~15.996	0~63.996
	Auto White Balance	0~15.996	0~63.996
ME2P-883-42U3M/C	Exposure	28~1000000	28~15000000
	Auto Exposure	28~1000000	28~15000000
	Gain	0~24	0~48
	Auto Gain	0~24	0~48
	Black Level	0~4095	0~4095
	Sharpness	0~3	0~63
	White Balance component	0~15.996	0~63.996
	Auto White Balance	0~15.996	0~63.996

ME2P-900-43U3M/C	Exposure	11~1000000	11~15000000
	Auto Exposure	11~1000000	11~15000000
	Gain	0~16	0~24
	Auto Gain	0~16	0~24
	Black Level	-256~2047	-256~2047
	Sharpness	0~3	0~63
	White Balance component	0~15.996	0~63.996
	Auto White Balance	0~15.996	0~63.996
ME2P-1230-23U3M/C	Exposure	28~1000000	28~15000000
	Auto Exposure	28~1000000	28~15000000
	Gain	0~24	0~48
	Auto Gain	0~24	0~48
	Black Level	0~4095	0~4095
	Sharpness	0~3	0~63
	White Balance component	0~15.996	0~31.996
	Auto White Balance	1~15.996	1~31.996
ME2P-1231-32U3M/C	Exposure	24~1000000	24~15000000
	Auto Exposure	24~1000000	24~15000000
	Gain	0~24	0~48
	Auto Gain	0~24	0~48
	Black Level	0~1023	0~1023
	Sharpness	0~3	0~63
	White Balance component	0~15.996	0~31.996
	Auto White Balance	0~15.996	0~31.996
ME2P-1231-32U3M POL	Exposure	24~1000000	24~15000000
	Auto Exposure	24~1000000	24~15000000
	Gain	0~24	0~48
	Auto Gain	0~24	0~48
	Sharpness	0~3	0~63

ME2P-1840-21U3M/C	Exposure	11~1000000	11~15000000
	Auto Exposure	11~1000000	11~15000000
	Gain	0~16	0~24
	Auto Gain	0~16	0~24
	Black Level	0~2047	0~2047
	Sharpness	0~3	0~63
	White Balance component	0~15.996	0~63.996
	Auto White Balance	0~15.996	0~63.996
ME2P-2621-15U3M/C	Exposure	11~1000000	11~15000000
	Auto Exposure	11~1000000	11~15000000
	Gain	0~16	0~24
	Auto Gain	0~16	0~24
	Black Level	0~1023	0~1023
	Sharpness	0~3	0~63
	White Balance component	0~15.996	0~31.996
	Auto White Balance	0~15.996	0~31.996
ME2P-2621-15U3M NIR	Exposure	11~1000000	11~15000000
	Auto Exposure	11~1000000	11~15000000
	Gain	0~16	0~24
	Auto Gain	0~16	0~24
	Black Level	0~1023	0~1023
	Sharpness	0~3	0~63
ME2P-2622-15U3M/C	Exposure	11~1000000	11~15000000
	Auto Exposure	11~1000000	11~15000000
	Gain	0~16	0~24
	Auto Gain	0~16	0~24
	Black Level	0~1023	0~1023
	Sharpness	0~3	0~63
	White Balance component	0~15.996	0~31.996
	Auto White Balance	0~15.996	0~31.996

ME2P-2622-15U3M NIR	Exposure	11~1000000	11~15000000
	Auto Exposure	11~1000000	11~15000000
	Gain	0~16	0~24
	Auto Gain	0~16	0~24
	Black Level	0~1023	0~1023
	Sharpness	0~3	0~63
ME2P-1230-30U3M/C-HS	Exposure	28~1000000	28~15000000
	Auto Exposure	28~1000000	28~15000000
	Gain	0~24	0~48
	Auto Gain	0~24	0~48
	Black Level	0~4095	0~4095
	Sharpness	0~3	0~63
	White Balance component	0~15.996	0~31.996
	Auto White Balance	1~15.996	1~31.996

Table 8-4 Parameter range of features supported before and after Remove Parameter Limits

8.3.17. User Data Area

8.3.17.1. User Data Area (16K)

The user data area is a FLASH data area reserved for the user, and the user can use the area to save algorithm factors, parameter configurations, etc.

The user data area is 16K bytes and is divided into 4 data segments, each of which is 4K bytes. The user can access the user data area through the API interface. The data is saved to the camera flash area immediately after being written, and the data will not disappear after the camera is powered off.

8.3.17.2. User Data Area (512K)

Some camera has a 512KB ROM area for storing large amounts of data and files. Users can access the user's data area through API. After writing, it will immediately saved into the camera's Flash area, and will not disappear after power down.

8.3.18. Timer

The camera only supports one timer (Timer1), which can be started by a specified event or signal (only ExposureStart signal is supported). The Timer can configure a timer output signal that goes high on a specific event or signal and goes low after a specific duration. And the timer is cleared when the output signal goes low. A schematic diagram of the timer working process is as follows:

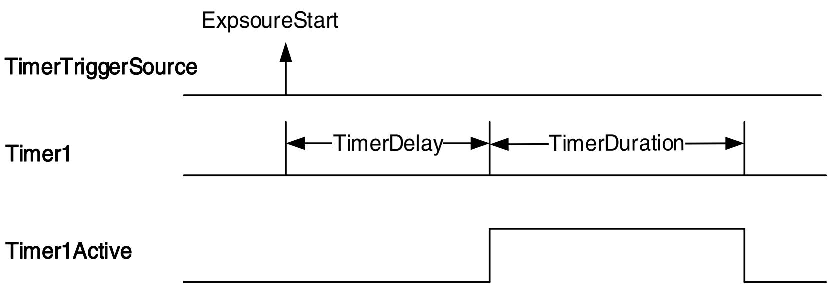


Figure 8-66 Timer1Active schematic diagram

The timer configuration process is as follows:

1. Set TimerSelector, currently only Timer1 supported.
2. Set LineSelector.
3. Set the LineSource to Timer1Active.
4. Set TimerTriggerSource, currently global shutter support ExposureStart and rolling shutter camera support Strobe, refer to 8.1.2 for details.
5. Set TimerDelay, the range of TimerDelay is [0, 16777215], the unit is μs.
6. Set TimerDuration, the range of TimerDuration is [0, 16777215], the unit is μs.
   1) From the start of the timer to the full output of Timer1Active, this process will not be interrupted by the ExposureStart signal, and Timer1Active must be completely output to start timing according to the next ExposureStart signal. As shown in the figure below, the red ExposureStart signals are ignored.

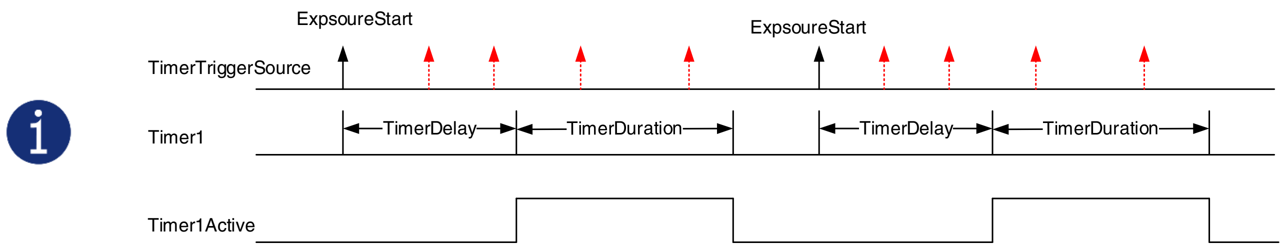


Figure 8-67 The relationship of Timer1Active and ExposureStart signal

   2) After the acquisition is stopped, the timer is immediately cleared and the Timer1Active signal goes low immediately.

8.3.19. Counter

The camera supports two counter (Counter1 and Counter2), but some models only support Counter1.

Counter1 can count the number of FrameTrigger, AcquisitionTrigger and FrameStart signals received by the camera. The counter starts counting from 0. You can select one of the above three signals to count by CounterEventSource. The FrameTrigger and AcquisitionTrigger signals of the counter statistics refer to the signals that have been triggered for filtering without a trigger delay.

If CounterValue is enabled, the statistical data can be inserted into the frame information and output with the image.

The counter can be reset by an external signal. The reset source is selected by CounterResetSource. Currently, the CounterResetSource option supports Off, SoftWare, Line0, Line2, and Line3. Among them, Off means no reset, SoftWare means software reset, Line0, Line2 or Line3 means reset through IO port input signal. The polarity of the reset signal only supports RisingEdge, which means reset the Counter on the rising edge of the reset signal.

Counter configuration:

1. Set CounterSelector, currently only Counter1 supported.
2. Set CounterEventSource, the values that can be set are FrameStart, FrameTrigger, AcquisitionTrigger.
3. Set CounterResetSource, the values that can be set are Off, SoftWare, Line0, Line2, Line3.
4. Set CounterResetActivation, currently only RisingEdge supported.

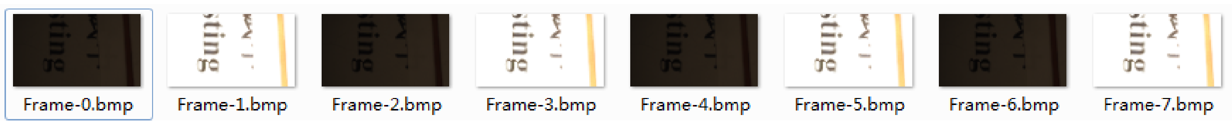
> 1) After the acquisition is stopped, the Counter1 continues to work, will not be cleared, and it will be cleared when the camera is powered off.
> 2) CounterReset is used to software reset the counter.
> 3) The Counter2 is used for the counter trigger function, refer to 8.2.9 for details.

8.3.20. Multi Gray Control

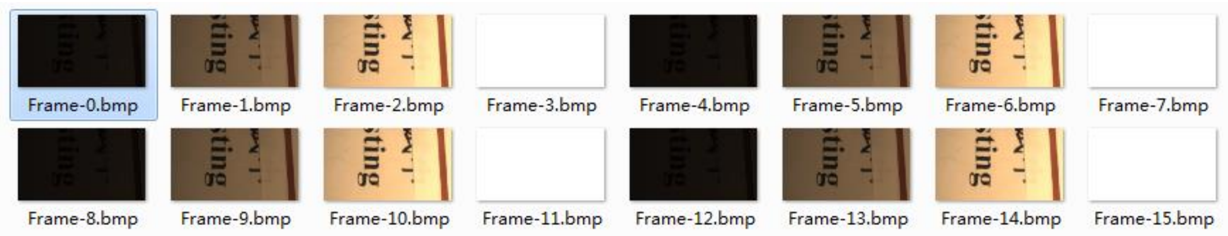
Multi-gray Control: The gray value of different frames can set by the parameters setting, which can realize HDR and other functional applications. Configurable parameters include MGCExposureTime and MGCGain. Multi-gray Control supports Off mode, 2Frame mode and 4Frame mode.

1) Off mode: That is Normal mode, the same MGCExposureTime and MGCGain parameters are in effect for each frame.

2) 2Frame mode: Two frames of different MGCExposureTime and MGCGain can be set. For example, you can set the MGCExposureTime and MGCGain of frame 0 to (1000μs, 0); and the parameters of frame 1 to (10000μs, 6.0); acquire 8 frames of images, and the effect is as follows:



3) 4Frame mode: Four frames of different MGCExposureTime and MGCGain can be set. For example, you can set the MGCExposureTime and MGCGain of frame 0 to (1000μs, 0); the parameters of frame 1 to (5000μs, 1.0); the parameters of frame 2 to (10000μs, 2.0); the parameters of frame 3 to (150000μs, 3.0); acquire 16 frames of images, and the effect is as follows:



Note for trigger mode：

1) Multi frames acquisition in one trigger command

a) In 2Frame mode, 2 images will be acquired after send one trigger command.

b) In 4Frame mode, 4 images will be acquired after send one trigger command.

2) Serial Software Trigger is not supported (When Multi Gray Control mode is on)

Serial Software Trigger: Send the next trigger immediately after receiving the last frame of image that acquired in this trigger.

When the Multi Gray Control mode is set to 2Frame or 4Frame mode, the software will send a trigger command immediately after receiving the last frame of image, and the camera will **not** respond to this trigger command, that is, **the trigger will be lost**. It is necessary to delay more than 20ms before sending the next software trigger command. So send Software Trigger command in timer is recommended.

3) In send trigger command in timer mode, the trigger frequency determined method is as follows:

a) Use the demo program to open the device, configure the Multi Gray Control parameters and set it to the required mode (2Frame or 4Frame).

b) Set <TriggerMode> to "ON".

c) View camera properties <CurrentAcquisitionFrameRate>.

d) When the Multi Gray Control is set to 2Frame mode, if the value of <CurrentAcquisitionFrameRate> is 31.0Hz, then the maximum trigger frequency is 31.0 / 2 = 15.5 Hz.

e) When the Multi Gray Control is set to 4Frame mode, if the value of <CurrentAcquisitionFrameRate> is 44.0Hz, then the maximum trigger frequency is 44.0 / 4 = 11 Hz.

8.4. Image Processing

8.4.1. Light Source Preset

1) MER2/ME2P/ME2S Series

The MER2/ME2P/ME2S series camera supports light source preset function, and provides Off mode, Custom mode, and four specified common color temperature light source modes. The camera provides the corresponding white balance coefficient and color transformation coefficient in the four specified color temperature light source modes. The function support of different models varies slightly.

- **Off Mode**

The camera does not perform white balance and color conversion processing on the image by default.

- **Custom Mode**

The camera does not perform white balance and color conversion processing on the image by default.

Users can perform automatic white balance, or manually input white balance coefficients, and it supports color conversion enable control and manually input color conversion coefficients.

- **Daylight-6500K**

When the user selects **Daylight-6500K** in the light source preset, the camera will perform white balance processing on the image by default. If the external environment light source used is D65 light source, the image will not produce color deviation.

Even if the current light source is selected as the light source preset, users can also manually adjust the white balance coefficient.

Users can turn on the color conversion enable switch and calibrate according to the color conversion coefficient of the **Daylight-6500K** light source (manual input of color correction coefficients is not supported).

The option operation of **Daylight5000K**, **CoolWhiteFluorescence**, **INCA** is the same as **Daylight-6500K**.

2) ME2L Series

The ME2L series camera supports light source preset function, and provides Off mode and four specified common color temperature light source modes.

- **Off Mode**

The camera does not perform white balance and color conversion processing on the image by default, and you need to input the white balance coefficient manually or use the auto white balance function. Perform color correction in Off mode is the same as without color correction.

- **Specified Color Temperature Modes (for example, Daylight-6500K)**

The camera performs white balance processing on the image by default, and supports manual modification of the white balance ratio under the current color temperature or auto white balance function. The color correction is enabled when the color correction check box is checked in the image processing plug-in.

8.4.2. Auto White Balance

MERCURY2 USB3 Vision camera supports auto white balance function and supports "Once" mode and "Continuous" mode. Auto white balance of ME2L series cameras is performed by software, so it has a certain impact on the acquisition performance. It only supports "Once" mode and "Manual" mode (auto white balance off mode).

- **Auto White Balance ROI**

Auto White Balance feature use the image data from AWBROI to calculate the white balance ratio, and then the white balance ratio is used to adjust the components of the image.

ROI is defined in the following way:

AWBROIOffsetX:	The offset of the X axis direction.
AWBROIOffsetY:	The offset of the Y axis direction.
AWBROIWidth:	The width of ROI.
AWBROIHeight:	The height of ROI.

Offset is the offset value that relative to the upper left corner of the image. Where the step of AWBROIOffsetX and AWBROIWidth is 4, the step of AWBROIOffsetY and AWBROIHeight is 2. The ROI setting depends on the current image's size and cannot exceed the current image range. Assuming the current image width is Width, the image height is Height, then the ROI setting need to meet the following condition 2:

$$AWBROIWidth + AWBROIOffsetX \le Width$$

$$AWBROIHeight + AWBROIOffsetY \le Height$$

If condition 2 is not met, the user cannot set the ROI.

The default value of ROI is the entire image, you can set the "white dot" area (ROI) according to your need. Where the minimum value of AWBROIWidth can be set is 16, the maximum value is equal to the current image width. The minimum value of AWBROIHeight can be set is 16, the maximum value is equal to the current image height, they are all need to meet the condition 2.

Assuming the current image width is 1024, the height is 1000, and then the "white dot" area ROI setting is:

AWBROIOffsetX =	100
AWBROIOffsetX =	50
AWBROIWidth =	640
AWBROIHeight =	480

The relative position of the ROI and the image is shown in Figure 8-68.

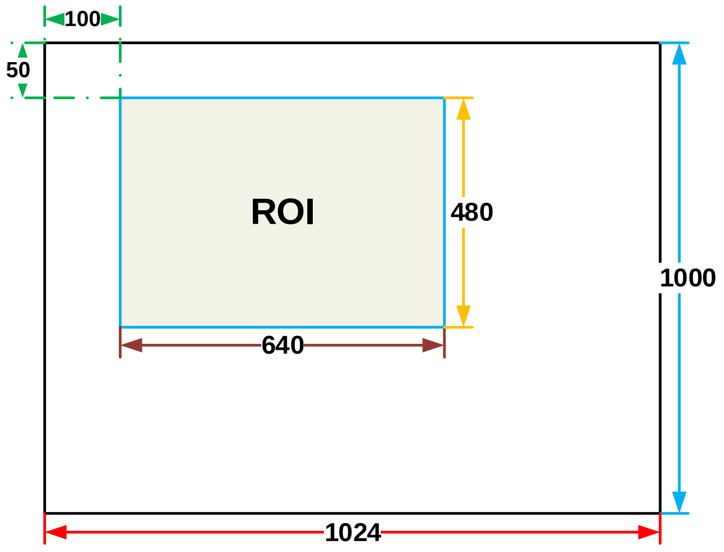


Figure 8-68 An example for the relative position between the ROI and the current image

- **Auto White Balance Adjustment**

Auto White Balance function calculates the white balance coefficient based on the data in ROI, and then use the coefficient to adjust the components of the image, in order to make the R/G/B component the same in the ROI. The Auto White Balance feature is only available on color sensors.

1) MER2/ME2P/ME2S Series

The auto white balance can be set to "Once" or "Continuous" mode. When using the "Once" mode, the camera just adjusts the white balance ratio once, when using the "Continuous" mode, the camera continuously adjusts the white balance ratio based on the data in AWBROI.

The auto white balance feature can also select the color temperature. When the color temperature of the selection is "Adaptive", the data in ROI always adjusting the red, green and blue to the same. When selecting the specific color temperature, the camera adjusts the factor according to the light source, so that the hue of the ROI is the same as the hue of the light source. That is: high temperature is cold, low color temperature is warm.

2) ME2L Series

The Auto White Balance can be set to "Once" mode.

When using the "Once" mode, the camera just adjusts the white balance ratio once.

8.4.3. Color Transformation Control

The Color Transformation is used to correct the color information delivered by the sensor, improve the color reproduction of the camera, and make the image closer to the human visual perception.

Figure 8-69 Color template

The user can use a color template containing 24 colors and shoot this color template with a camera, the RGB value of each color may be different from the standard RGB value of the standard color template, the vendor can use the software or hardware to convert the RGB value that is read to the standard RGB value. Because the color space is continuous, all the other RGB values that are read can be converted to the standard RGB values by using the mapping table created by the 24 colors.

1) Prerequisites

For the color transformation to work properly, the white balance must first be configured appropriately.

2) Configuring color transformation

- **MER2/ME2P/ME2S Series**

There are two modes for configuring color transformation: default mode (RGBtoRGB), user-defined mode (User).

RGBtoRGB: Default color transformation parameters provided to the camera when it leaves the factory.

User:

a) Set the **ColorTransformationValueSelector** parameter to the expected position in the matrix, e.g., Gain00.

b) Enter the expected value for the **ColorTransformationValue** parameter to adjust the value at the selected position. The parameter's value range is -4.0 to +4.0.

In user mode, the user can input the color transformation value according to the actual situation to achieve the color transformation effect.

- **ME2L Series**

The camera stores the color correction parameters under different light sources. The interface of image processing library realizes the color correction function, which is divided into 2 steps.

a) Call the camera interface library to get the color correction parameters.

b) Call the image processing library interface and pass in the color correction parameters to realize the color correction function.

Color correction function can be used with the Gamma function to get better results. The realization of Gamma function is also require calling the image processing library. The Gamma value is passed into the Gamma function realization interface according to actual needs, and the recommended Gamma is 1.8~2.2.

3) How it works

The color correction function uses a transformation matrix to modify red, green, and blue pixel data for each pixel.

The color transformation is performed by premultiplying a 3×1 matrix which containing R, G, and B pixel values by a 3×3 matrix which containing the color transformation values:

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

4) Effect images

Figure 8-70 Before color transformation

Figure 8-71 After color transformation

8.4.4. Gamma

The Gamma can optimize the brightness of acquired images for display on a monitor.

1) Prerequisites

If the **GammaEnable** parameter is available, it must be set to **true**.

2) How it works

The camera applies a Gamma correction value (γ) to the brightness value of each pixel according to the following formula (red pixel value (R) of a color camera shown as an example):

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

The maximum pixel value (R_{max}) equals, e.g., 255 for 8-bit pixel formats, 1023 for 10-bit pixel formats or 4095 for 12-bit pixel formats.

3) Enabling Gamma correction

After enabling Gamma correction, set **GammaValue** to change the image brightness. The range of **GammaValue** is 0 to 4.00.

a) Gamma = 1.0: the overall brightness remains unchanged.

b) Gamma < 1.0: the overall brightness increases.

c) Gamma > 1.0: the overall brightness decreases.

In all cases, black pixels (gray value = 0) and white pixels (gray value = maximum) will not be adjusted.

If you enable Gamma correction and the pixel format is set to a 10-bit or 12-bit, some image information will be lost. Pixel data output will still be 10-bit or 12-bit, but the pixel values will be interpolated during the Gamma correction process, resulting in loss of accuracy and loss of image information. If the Gamma feature is required and no image information is lost, avoid using the Gamma feature in 10-bit or 12-bit pixel format.

4) Additional parameters

Depending on your camera model, the following additional parameters are available:

a) GammaEnable: Enable or disable Gamma correction.

b) GammaMode: You can select one of the following Gamma correction modes:

User: The Gamma correction value can be set as expected.

sRGB: The camera's internal default Gamma correction value. This feature is used with the color transformation feature to convert images from RGB to sRGB. It is recommended to adjust Gamma to sRGB mode after enabling the color transformation feature.

8.4.5. Lookup Table

When the analog signal that is read out by the sensor has been converted via ADC, generally, the raw data bit depth is larger than 8 bits, there are 12 bits, 10 bits, etc. The feature of lookup table is to replace some pixel values in the 8 bits, 10 bits, and 12 bits images by values defined by the user.

The lookup table can be a linear lookup table or a non-linear lookup table, created entirely by the user.

You can also use the **LUTValueAll** function to create an entire lookup table.

1) How it works

a) LUT is short for "lookup table", which is basically an indexed list of numbers.

b) In the lookup table you can define replacement values for individual pixel values. For example, you can replace a gray value of 0 (= minimum gray value) by a gray value of 1023 (= maximum gray value for 10-bit pixel formats). This changes all black pixels in your images to white pixels.

c) Setting a user-defined LUT can optimize the luminance of images. By defining the replacement values in advance and storing them in the camera to avoid time-consuming calculations. The camera itself has a factory default lookup table, and the default lookup table does not affect image luminance.

2) Creating the user-defined LUT

To create a lookup table, you need to determine the range of **LUTIndex** and **LUTValue** parameters by the maximum pixel format supported by the currently used camera.

a) On cameras with a maximum pixel bit depth of 12 bits

The **LUTIndex** selectable item is 0-4095, each **LUTIndex** corresponds to a **LUTValue**, and the **LUTValue** range is [0,4095].

b) On cameras with a maximum pixel bit depth of 10 bits

The **LUTIndex** selectable item is 0-1023, each **LUTIndex** corresponds to a **LUTValue**, and the **LUTValue** range is [0,1023].

Create a user-defined lookup table with the following steps:

1) Select the lookup table to use. Since there is only one user-defined lookup table in the camera, there is no need to select it by default.

2) Set the **LUTIndex** parameter to the pixel value that you want to replace with a new value.

3) Set the **LUTValue** parameter to the new pixel value.

4) Repeat steps 1 and 2 for all pixel values that need to be changed to set the parameters to the target pixel values in turn.

5) Set the **LUTEnable** parameter to **true** means that the lookup table feature is enabled. The default is disabled.

If you want to replace all pixel values, it is recommended to use the **LUTValueAll** function. See the **LUTValueAll** sample code in the Development User Manual for details.

8.4.6. Sharpness

The sharpness algorithm integrated in the camera can significantly improve the definition of the edges of the image. The higher the definition, the clearer the contour corresponding to the image. This feature can improve the accuracy of image analysis, thus improving the recognition rate of edge detection and OCR.

The sharpness supported by the camera include sharpness and sharpness with noise suppression

8.4.6.1. Sharpness

- Enable sharpness

ON means that the sharpness feature is enabled.

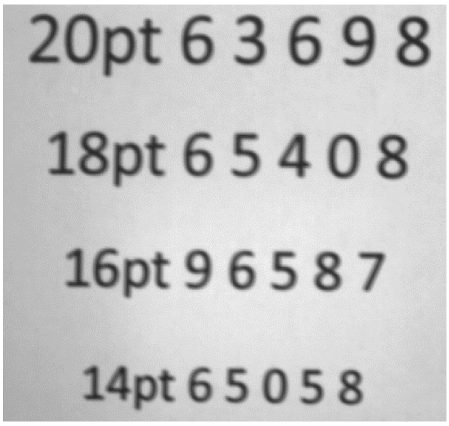


Figure 8-72 Before sharpness adjustment

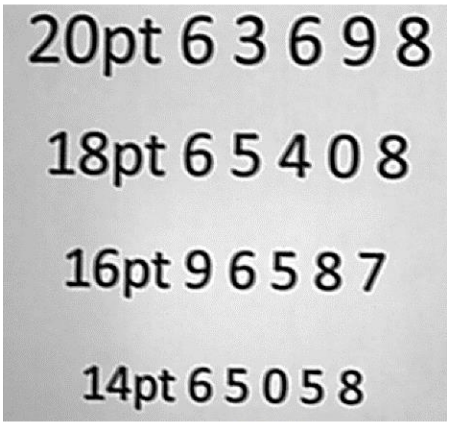


Figure 8-73 After sharpness adjustment

- Sharpness adjustment

Adjust the sharpness value can adjust the camera's sharpness to the image. The adjustment range is 0-3.0. The larger the value, the higher the sharpness.

8.4.6.2. Sharpness with Noise Suppression

- Enable sharpness

ON means that the sharpness feature is enabled.

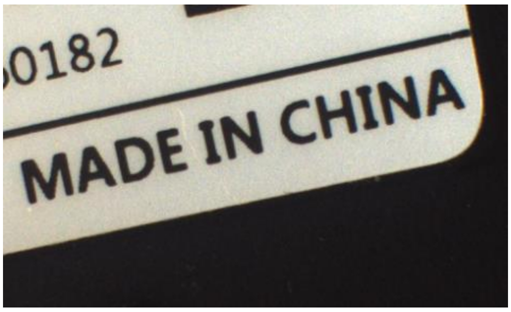


Figure 8-74 Before sharpness adjustment

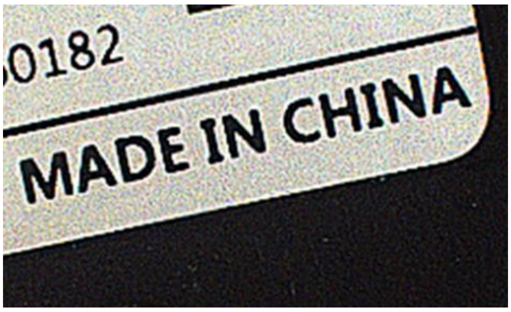


Figure 8-75 After sharpness adjustment

- Sharpness adjustment

Adjust the sharpness value can adjust the camera's sharpness to the image. The adjustment range is 0-7.0. The larger the value, the higher the sharpness.

- Sharpness noise suppression threshold adjustment

Adjust the sharpness noise suppression threshold can reduce the noise of homogeneous area. It is suitable for noise caused by high intensity sharpness. The adjustment range is 0-1. The larger the value, the higher the noise suppression.

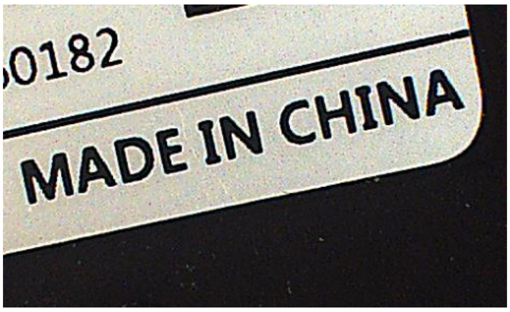


Figure 8-76 After sharpness noise suppression

8.4.7. Flat Field Correction

During the use of the camera, there may be various inconsistencies in the image, which are mainly reflected in the following aspects:

1) Inconsistent response of individual pixels.

2) The difference in gray value between the image center and the edge.

3) Non-uniform illumination.

The Flat Field Correction (FFC) feature can correct the inconsistency of the image. As shown below, the FFC can adjust the pixel values of different positions to the same gray value.

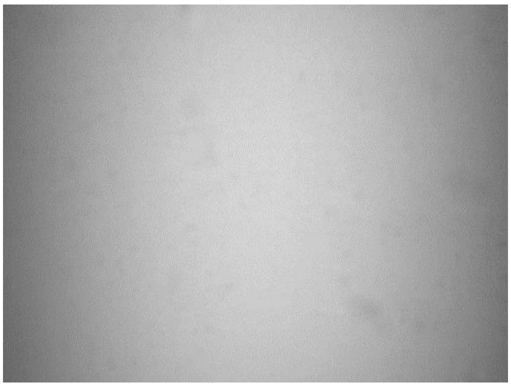


Figure 8-77 Before FFC

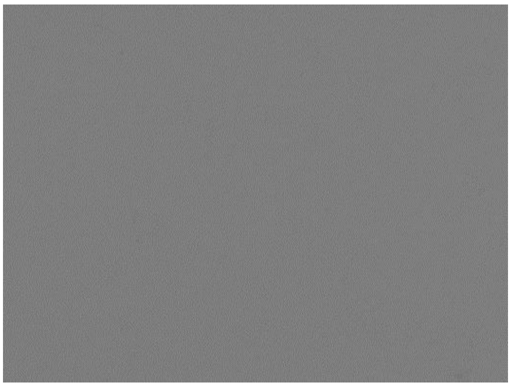


Figure 8-78 After FFC

The FFC Plugin can be used to obtain, save and preview the FFC coefficient. The plugin interface is shown in Figure 8-79:

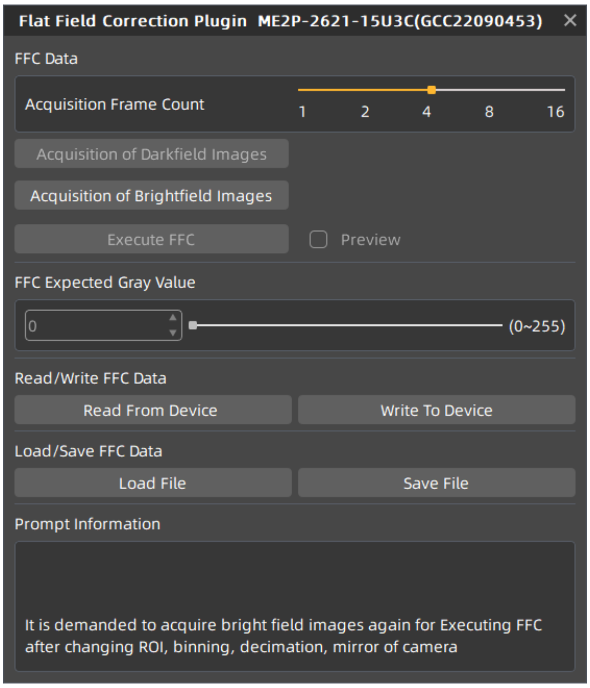


Figure 8-79 FFC Plugin interface

It is demanded to acquire bright field images again for executing FFC after changing ROI, Binning, Decimation, Reverse X/Y of the cameras that support FFC. The previous factor will no longer apply.

There are three ways to obtain the FFC coefficient:

- According to the current environment
- Read from device (available for part of the camera)
- Load file

There are two ways to save the FFC coefficient:

- Write to device (available for part of the camera)
- Save file

For cameras that support FFC, In addition to the plugin, FFC can be set to on/off in the camera feature. When set to on, FFC coefficients stored in the camera can be used to correct the image.

The following will describe: FFC coefficient calculation and preview, FFC coefficient reading and saving, file loading and saving.

8.4.7.1. FFC Coefficient Calculation and Preview

Before the FFC coefficient is obtained, it is recommended to determine the aperture of the lens and the gain of the camera. In the following cases, the coefficient needs to be re-calculated.

- Lens is replaced
- If the requirement for FFC accuracy is high (if the purpose is to correct the inconsistency of the pixels), it is recommended to recalculate the FFC coefficient after modifying the gain of the camera

According to the FFC plugin, the process of obtaining FFC coefficient is shown in the figure below, and the yellow part are optional steps. For details of the FFC plugin, please see section 9.2.

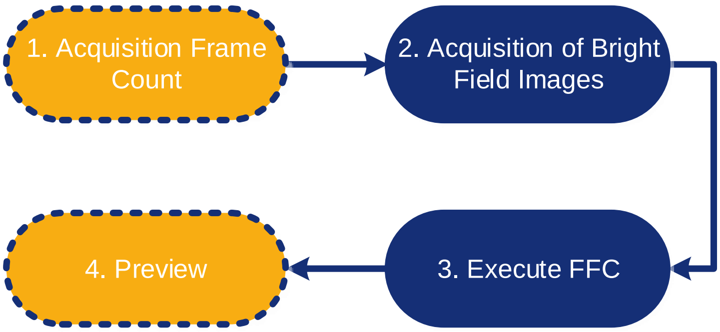


Figure 8-80 The process of obtaining FFC coefficient

1. **Acquisition frame count: acquisition frame count for the bright field image to obtain the average image.**

   - It is not a necessary step, generally the default value is used
   - If the image noise is high, it is recommended to increase the acquisition frame count

2. **Acquisition of bright field images: perform this function to complete the bright field image acquisition.**

   - It is recommended to align the white paper or the flat fluorescent lamp (to ensure the same amount of light in different areas of the sensor), and adjust the distance between the camera and the white paper/flat fluorescent lamp to fill the entire field of view
   - Do not overexpose the image. The gray value of the brightest area of the brightfield is recommended to be less than 250
   - The image should not be too dark. The gray value of the darkest area of the brightfield is recommended to be greater than 20
   - It is recommended to control the bright field gray value by adjusting the exposure time or light source, and do not adjust the aperture

3. **Execute FFC: Calculate the FFC coefficient using the acquired image. After execution, the subsequent image automatically use the calculated factors for FFC.**

4. **Preview: Preview the effect of the current FFC.**

8.4.7.2. Read/Save Coefficient

- Read coefficient: The saved correction coefficient can be read from the device

- Save coefficient: Save the current FFC coefficient to the device. The coefficient can still be saved after the camera is powered down

Available for part of the camera models: models that implement FFC in the camera. Other models are grayed out.

8.4.7.3. Load/Save File

- Load from file: Load the saved FFC coefficient file (format: .ffc) from the file

- Save to file: Save the current factor to the FFC coefficient file (format: .ffc)

8.4.7.4. Precautions

The FFC coefficient is associated with the camera's features such as ROI, Binning, Decimation and Reverse X/Y. When the relevant parameters change, users need to perform FCC again to obtain the FFC coefficient. Otherwise, the correction data may be inconsistent with the current FFC coefficient, resulting in invalid FFC or unusual image.

For example: If FCC has been performed at a certain resolution and FFC coefficient has been written to the device, if you need to adjust ROI or set Binning (Decimation), Reverse X/Y and other parameters, you can follow the following steps:

1) Switch the FFC switch from on to off.

2) Stop the acquisition, modify the ROI to the expected value or set Binning (Decimation), Reverse X/Y and other parameters.

3) Start the acquisition, open the FFC plugin, and execute FFC coefficient calculation and save in order.

At this point, the FFC can be used normally under the new FFC coefficient.

8.4.8. Noise Reduction

During the digitization and transmission of an image, it is often disturbed by the noise of the imaging device and the external environment, which will cause the image with noise. The process of reducing or suppressing the noise in the image is called image noise reduction.

Adjust the noise reduction value can adjust the noise reduction intensity of the camera on the image. The adjustment range is 0-4.0. The larger the value, the higher the degree of noise reduction.

Noise reduction feature: determine whether to enable noise reduction. ON means that the noise reduction feature is enabled. And OFF means that the noise reduction feature is disabled.

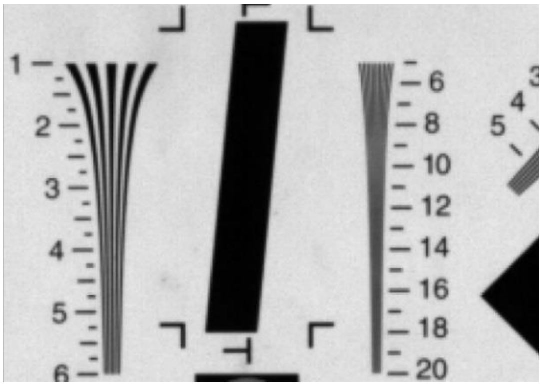


Figure 8-81 Before noise reduction

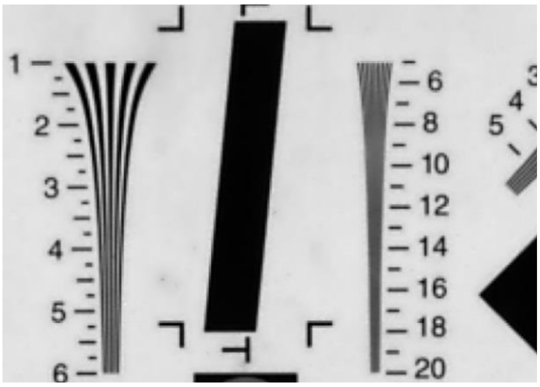


Figure 8-82 After noise reduction

8.4.9. Saturation

Some MERCURY2 USB3 cameras support saturation function. Saturation function can changes the colorfulness (intensity) of the colors to achieve the goal image effect.

1) Prerequisites

If the **SaturationEnable** parameter is available, it must be set to **On**.

2) Configuring saturation

Enter the expected value for the Saturation parameter and the range is 0 to 128. By default, the parameter is set to 64 (no saturation perform)

3) How it works

The saturation adjustment is performed by a 3 × 3 matrix. When the saturation intensity is modified, the saturation can be changed by modifying the adjustment matrix A.

$$\begin{bmatrix} R_{out} \\ G_{out} \\ B_{out} \end{bmatrix} = \begin{bmatrix} RR & GR & BR \\ RG & GG & BG \\ RB & GB & BB \end{bmatrix} \begin{bmatrix} R_{in} \\ G_{in} \\ B_{in} \end{bmatrix} + \begin{bmatrix} R_{offset} \\ G_{offset} \\ B_{offset} \end{bmatrix} \quad A = \begin{bmatrix} RR & GR & BR \\ RG & GG & BG \\ RB & GB & BB \end{bmatrix}$$

Saturation adjustment and color correction adjustment both adopt the form of a matrix, so the saturation is adjusted at the same time after color correction is enabled.

4) Effect images

Figure 8-83 Before saturation

Figure 8-84 After saturation

8.4.10. MultiColor Adjustment

The MultiColor adjustment function be used to adjust the hue, saturation and brightness of individual colors in camera images. This can improve the accuracy of image analysis, and adapt to changing environmental conditions. It includes six preset hues (Red(330,360]&(0,30], Yellow(30,90], Green(90,150], Cyan(150,210], Blue(210,270], Magenta(270,330])) and a Custom.

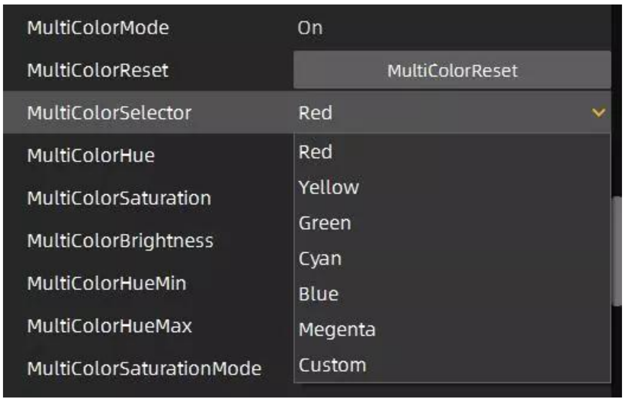


Figure 8-85 MultiColorSelector

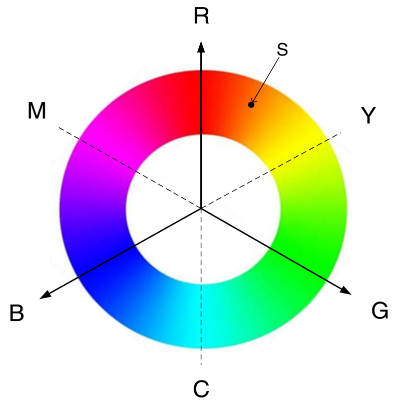


Figure 8-86 color wheel

1) Prerequisites

To use the MultiColor adjustment function, first you need to determine which range the color to be adjusted belongs to.

2) Configuring Parameters

- **Hue**

Hue function can changes the hue of the colors to make the colors achieve the goal image effect. For example: If you need to adjust all red colors to green (red color rotated 120° clockwise), you can set the **MultiColorSelector** to Red, the **MultiColorHue** to 120, and the **MultiColorMode** to On, the parameters are set as follows:

MultiColorMode	On
MultiColorReset	MultiColorReset
MultiColorSelector	Red
MultiColorHue	120.0000
MultiColorSaturation	0.0000
MultiColorBrightness	0.0000
MultiColorHueMin	330.0000
MultiColorHueMax	30.0000
MultiColorSaturationMode	Relative

Figure 8-87 MultiColorHue

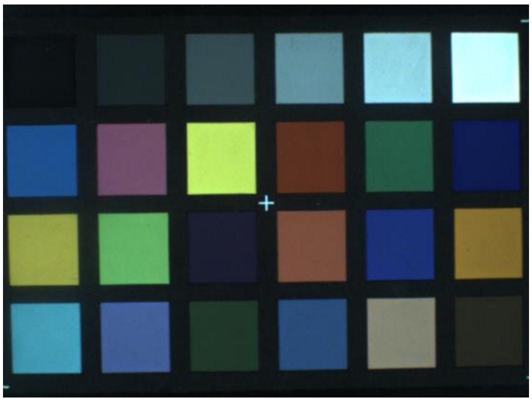


Figure 8-88 Before MultiColorHue

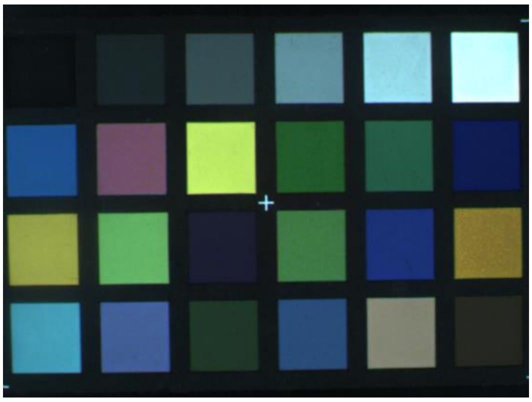


Figure 8-89 After MultiColorHue

- **Saturation**

MultiColorSaturation function can individually adjust the colorfulness of a particular hue or a specific hue and the range is -100 to +100. By default, the parameter is set to 0 (no saturation perform). Increasing the parameter can be useful to make the target easier to distinguish.

MultiColorSaturation contains two modes: Absolute and Relative. Absolute mode has a larger adjustment range, but the image is not smooth enough, resulting in the existence of the image of the sense of split. Relative adjustment is more natural. If you want to smoothly improve the saturation of the yellow, you can set the **MultiColorSelector** to yellow, **MultiColorSaturation** to 100, **MultiColorSaturationMode** to relative, and **MultiColorMode** to On, the parameters are set as follows:

MultiColorMode	On
MultiColorReset	MultiColorReset
MultiColorSelector	Yellow
MultiColorHue	0.0000
MultiColorSaturation	100.0000
MultiColorBrightness	0.0000
MultiColorHueMin	30.0000
MultiColorHueMax	90.0000
MultiColorSaturationMode	Relative

Figure 8-90 MultiColorSaturation

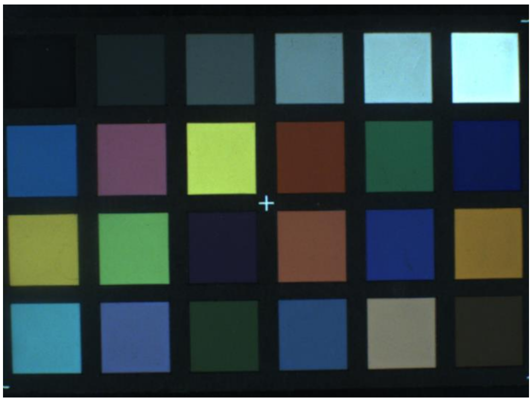


Figure 8-91 Before MultiColorSaturation

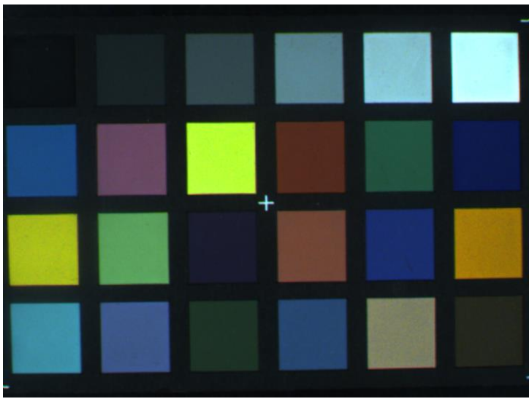
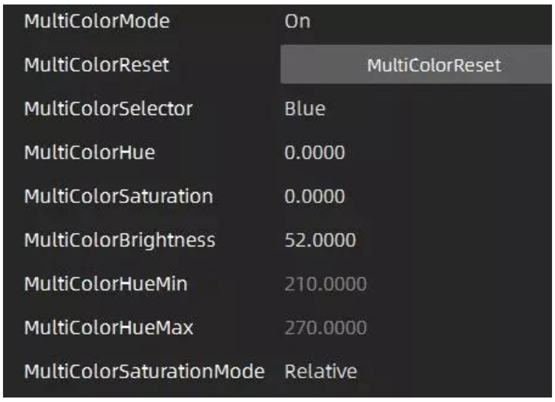


Figure 8-92 After MultiColorSaturation

- **Brightness**

MultiColorBrightness function can individually adjust the brightness of a particular hue and the range is -100 to +100. By default, the parameter is set to 0 (no saturation perform). Increasing the parameter can be useful to make the target brighter. If you want to improve the brightness of the blue, you can set the **MultiColorSelector** to blue, **MultiColorBrightness** to 52, and **MultiColorMode** to On, the parameters are set as follows:



MultiColorMode	On
MultiColorReset	MultiColorReset
MultiColorSelector	Blue
MultiColorHue	0.0000
MultiColorSaturation	0.0000
MultiColorBrightness	52.0000
MultiColorHueMin	210.0000
MultiColorHueMax	270.0000
MultiColorSaturationMode	Relative

Figure 8-93 MultiColorBrightness

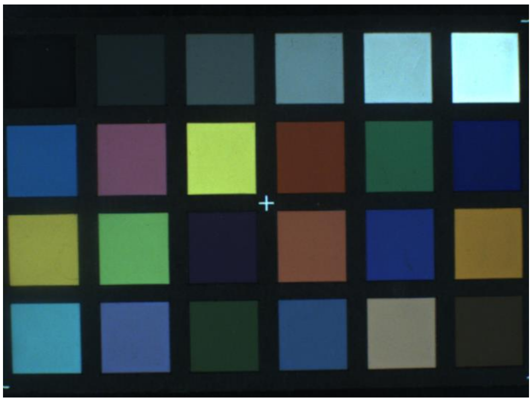


Figure 8-94 Before MultiColorBrightness

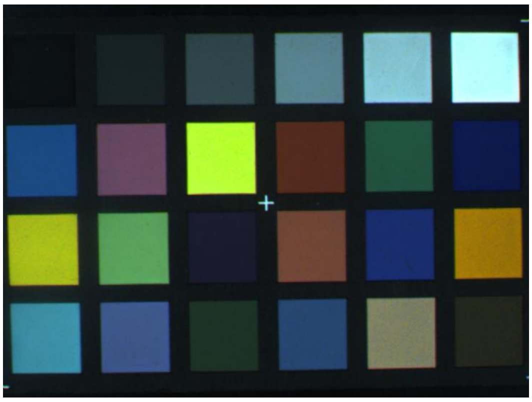


Figure 8-95 After MultiColorBrightness

- **Custom mode**

When the preset color does not meet the demand, such as in the saturation adjustment above, when adjusting the saturation of the yellow, the three color blocks (the third one in the second row, the first one in the third row, and the last one in the third row) all belong to the yellow color, and therefore all of them change the saturation. If you only want to adjust the third row of the last color block, you can follow the following steps:

a) Switch the **MultiColorMode** from on to off.

b) The original RGB values of the three color blocks are used to calculate the hue range before adjustment.

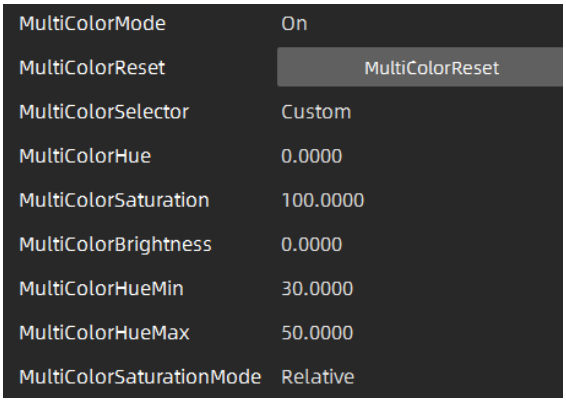
The three color blocks RGB average values, e.g., (255, 255, 160), (245, 255, 120) and (190, 160, 73), are calculated to correspond to hues of approximately 60°, 64°, and 45°, respectively, according to the formula below.

$$H=\begin{cases} 60°\times\left(\frac{G-B}{R-MIN}+0\right) & R\ max \\ 60°\times\left(\frac{B-R}{G-MIN}+2\right) & G\ max \\ 60°\times\left(\frac{R-G}{B-MIN}+4\right) & B\ max \end{cases}$$

The target color block is more different from the other two so it can be adjusted using a custom mode.

c) Click the **MultiColorReset** button to reset the parameter settings in the preset color hue.

d) Switch the **MultiColorSelector** to Custom and the setup parameters are as follows:



MultiColorMode	On
MultiColorReset	MultiColorReset
MultiColorSelector	Custom
MultiColorHue	0.0000
MultiColorSaturation	100.0000
MultiColorBrightness	0.0000
MultiColorHueMin	30.0000
MultiColorHueMax	50.0000
MultiColorSaturationMode	Relative

Figure 8-96 Custom mode

Figure 8-97 Before Custom

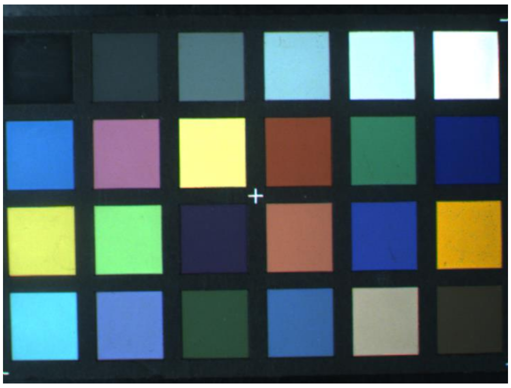


Figure 8-98 After Custom

This function is not suitable for use in great image noise situations.

8.4.11. Fixed Pattern Noise Correction

Due to some defects in the sensor itself, the output image may have some regular horizontal stripes or vertical stripes. These regular noises can be removed by set the **FixedPatternNoiseCorrectMode** to On.

However, it should be noted that removing these noises will have an impact on the quality of the image. Fixed Pattern Noise Correction feature is only supported by some cameras.

ME2S-138-136U3M-SWIR、ME2S-138-232U3M-SWIR camera: The default switch status is off.

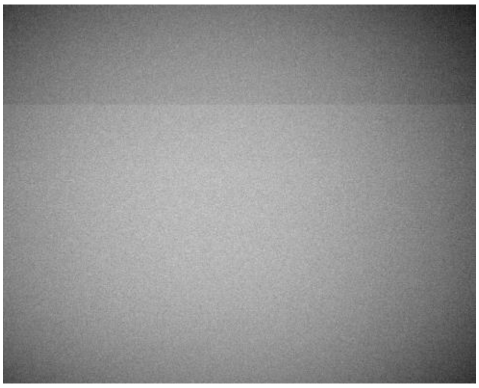


Figure 8-99 The original image

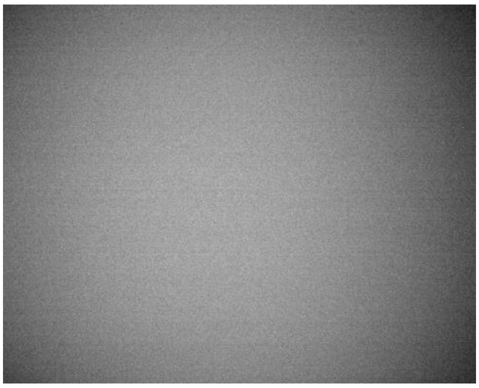


Figure 8-100 After correction

8.4.12. Defect Pixel Correction

Due to the technical defects of the image sensor, the camera has defect pixels. Some of these defect pixels are fixed at the same gray value and do not change with the scene, which are called dead pixels. In acquired images, some pixels may appear significantly brighter or darker than the rest, even if uniform light is used, resulting in a significant difference between the gray value and the surrounding pixels, which is called dark pixels or bright pixels.

The defect pixel correction feature can automatic judge the brightness of pixels with significant differences from their surroundings, and using surrounding pixels modify the gray value of these judged bad pixels.

Defect pixels will affect the visual experience and further image processing. But some cameras can solve it better with defect pixel correction. If the gain is too large or a higher quality image is required, then, this function would be a great help.

8.5. Image Transmission

8.5.1. Frame Buffer Control

Frame buffer control allows for adjusting the maximum number of frames cached in the camera. The primary configurable parameters include: FrameBufferCount and FrameBufferOverwriteActive.

8.5.1.1. FrameBufferCount

FrameBufferCount refers to the number of image frames that can be stored in a camera. Some camera models support customizable settings, with a minimum configurable count of 2. The maximum configurable count depends on factors such as ROI size, pixel format, and whether frame information is enabled.

- A larger FrameBufferCount provides stronger resistance to bandwidth fluctuations in the transmission interface. Temporary data transfer blockages are less likely to cause buffer underflow and frame loss, though this configuration may compromise real-time image transmission performance.
- A smaller FrameBufferCount keeps real-time image transmission but exhibits weaker tolerance to bandwidth fluctuations. Data transfer blockages in such scenarios can easily lead to buffer underflow and frame loss

8.5.1.2. FrameBufferOverwriteActive

Some MERCURY2 camera models support frame buffer overwrite active control, allowing users to enable or disable the overwrite functionality based on specific application requirements.

When the FrameBufferOverwriteActive is enabled, if transmission interface congestion causes insufficient frame buffer space in the camera, the latest frame will overwrite partially cached images, triggering buffer underflow and frame loss. Each overwrite event results in the loss of (frame buffer depth - 1) previous frames.

When the FrameBufferOverwriteActive is disabled, if transmission interface congestion causes insufficient frame buffer space in the camera, new image frames will be discarded until previous frames are read out and buffer is released.

For scenarios requiring high real-time image acquisition performance, it is recommended to use a smaller FrameBufferCount combined with FrameBufferOverwriteActive to ensure real-time image transmission.

8.5.2. Calculate Frame Rate

1) Frame Period

You can calculate the frame period of the MERCURY2 USB3 Vision series camera by the following formula:

$$T_f = \mathrm{Max}\left(\frac{\mathrm{ImageSize}\times 10^6}{\mathrm{BandWidth}_{USB}}, \frac{\mathrm{ImageSize}\times 10^6}{\mathrm{DeviceLinkThroughputLimit}}, T_{acq}, T_{exp}\right)$$

Among them:

$$\mathrm{ImageSize} = \mathrm{Width} \times \mathrm{Height} \times \mathrm{PixelSize} + 84$$

T_f: The camera's frame period, unit: μs.

Width: The current image width.

Height: The current image height.

PixelSize: The size of the pixel, in 8bit mode, the value is 1, and in 10bit/12bit mode, the value is 2.

$\mathrm{BandWidth}_{USB}$: The bandwidth of the USB interface, unit: Bps.

DeviceLinkThroughputLimit: The limit of the device link throughput bandwidth, unit: Bps.

T_{acq}: The acquisition time of the camera, unit: μs.

T_{exp}: The exposure time of the camera, unit: μs.

2) Frame rate (Unit: fps)

$$F = \frac{10^6}{T_f}$$

It is recommended to use the frame rate calculation tool, the frame rate will be calculated automatically after the configuration parameters are filled.

8.5.3. USB Interface Bandwidth

The theoretical bandwidth of the USB3.0 interface is 400MBps, but actually the value will decrease with the type of the USB3.0 host controller, the version of the host controller driver, the wastage of the HUB and the host performance. The user can refer the test result of the interface bandwidth in <TN-USB3.0 host controller bandwidth and CPU utilization> document.

8.5.4. DeviceLinkThroughputLimit

The MERCURY2 USB3 Vision camera provides bandwidth limit function, in order to control the upper limit bandwidth of single device. When the DeviceLinkThroughputLimit is greater than the current device acquisition bandwidth, the current device acquisition bandwidth will not change, when the DeviceLinkThroughputLimit is less than the current device acquisition bandwidth, the current device acquisition bandwidth will be reduced to the limit of the DeviceLinkThroughputLimit, the current device acquisition bandwidth can be read from the camera.

When the camera is working in trigger mode, the bandwidth limit will restrict the maximum trigger frequency.

Example 1:

The MER2-502-79U3M/C(-L) is working in continuous mode, the DeviceLinkCurrentThroughput is 35000000Bps, the DeviceLinkThroughputLimit is 40000000Bps, and then the DeviceLinkCurrentThroughput is still 35000000Bps. If the DeviceLinkCurrentThroughput is 70000000Bps, the DeviceLinkThroughputLimit is 40000000Bps, and then the DeviceLinkCurrentThroughput will be 40000000Bps.

Example 2:

The MER2-502-79U3M/C(-L) is working in trigger mode, the DeviceLinkCurrentThroughput is 300000000Bps, the maximum trigger frequency is 59.8Hz @ full resolution (8bit), when the DeviceLinkCurrentThroughput is 35000000Bps, the maximum trigger frequency is 6.9Hz @ full resolution (8bit).

Model	Min. of DeviceLinkThroughputLimit	Max. of DeviceLinkThroughputLimit	Step of DeviceLinkThroughputLimit
MER2-U3(-L)	35000000Bps (8bit)	400000000Bps	1000000Bps
	70000000Bps (10bit)		
	70000000Bps (12bit)		

ME2S-U3	35000000Bps (8bit)	400000000Bps	1000000Bps
	700000000Bps (10bit)		
	700000000Bps (10bit)		
ME2P-U3	35000000Bps (8bit)	400000000Bps	1000000Bps
	70000000Bps (12bit)		
ME2L-U3(-L)	35000000Bps (8bit)	200000000Bps	1000000Bps
	700000000Bps (10bit)		
	700000000Bps (10bit)		

Table 8-5 MERCURY2 USB3 Vision camera bandwidth control

8.5.5. Camera Acquisition Time

The acquisition time of the camera is related to the OffsetY and height of the image ROI. When the OffsetY and height change in the ROI setting, it will affect the frame period captured by the camera front end, which will affect the acquisition frame rate.

The formulas are as follows:

- MER2-041-436U3M/C(-L)

The row period (unit: μs):

$$T_{row} = \frac{147}{37.5} = 3.92$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 32) \times T_{row}$$

- MER2-041-528U3M/C(-L)

When the sensor bit depth is BPP8, the row period (unit: μs):

$$T_{row} = \frac{130}{40} = 3.25$$

When the sensor bit depth is BPP10, the row period (unit: μs):

$$T_{row} = \frac{157}{40} = 3.925$$

When the sensor bit depth is BPP12, the row period (unit: μs):

$$T_{row} = \frac{214}{40} = 5.35$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 42) \times T_{row}$$

- MER2-060-642U3M(-L)

When the pixel format is Mono8, the row period (unit: μs):

$$T_{row} = \frac{144}{80} = 1.8$$

When the pixel format is Mono10, the row period (unit: μs):

$$T_{row} = \frac{288}{80} = 3.6$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 25) \times T_{row}$$

- MER2-135-150U3M/C(-L)

The row period (unit: μs):

$$T_{row} = \frac{253}{40} = 6.325$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 30) \times T_{row}$$

- MER2-135-208U3M/C(-L)

The row period (unit: μs):

$$T_{row} = \frac{182}{40} = 4.55$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 30) \times T_{row}$$

- MER2-160-227U3M/C(-L)

When the pixel format is Mono8 or BayerRG8, the row period (unit: μs):

$$T_{row} = \frac{157}{40} = 3.925$$

When the pixel format is Mono10 or BayerRG10, the row period (unit: μs):

$$T_{row} = \frac{157 \times 2}{40} = 7.85$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 42) \times T_{row}$$

- MER2-230-168U3M/C(-L)

When the pixel format is Mono8 or BayerRG8, the row period (unit: μs):

$$T_{row} = \frac{192}{40} = 4.8$$

When the pixel format is Mono10 or BayerRG10, the row period (unit: μs):

$$T_{row} = \frac{192 \times 2}{40} = 9.6$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 38) \times T_{row}$$

- MER2-231-41U3M/C(-L)

The row period (unit: μs):

$$T_{row} = \frac{796}{40} = 19.9$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 38) \times T_{row}$$

- MER2-240-159U3M/C(-L)

When the pixel format is Mono8 or BayerGB8, the row period (unit: μs):

$$T_{row} = \frac{335}{66.67} = 5.025$$

When the pixel format is Mono10 / Mono12 / BayerGB10 / BayerGB12, the row period (unit: μs):

$$T_{row} = \frac{670}{66.67} = 10.05$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 24) \times T_{row}$$

- MER2-280-139U3M/C(-L)

When the pixel format is Mono8 or BayerRG8, the row period (unit: μs):

$$T_{row} = \frac{188}{40} = 4.7$$

When the pixel format is Mono10 / Mono12 / BayerRG10 / BayerRG12, the row period (unit: μs):

$$T_{row} = \frac{376}{40} = 9.4$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 64) \times T_{row}$$

- MER2-301-125U3M/C(-L)

When the pixel format is Mono8 or BayerRG8, the row period (unit: μs):

$$T_{row} = \frac{203}{40} = 5.075$$

When the pixel format is Mono10 or BayerRG10, the row period (unit: μs):

$$T_{row} = \frac{406}{40} = 10.15$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 38) \times T_{row}$$

- MER2-302-56U3M/C(-L)

The row period (unit: μs):

$$T_{row} = \frac{452}{40} = 11.3$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 32) \times T_{row}$$

- MER2-303-107U3M/C(-L)

When the pixel format is Mono8 or BayerRG8, the row period (unit: μs):

$$T_{row} = \frac{236}{40} = 5.9$$

When the pixel format is Mono12 or BayerRG12, the row period (unit: μs):

$$T_{row} = \frac{236 \times 2}{40} = 11.8$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 38) \times T_{row}$$

- MER2-304-56U3M/C(-L)

The row period (unit: μs):

$$T_{row} = \frac{452}{40} = 11.3$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 38) \times T_{row}$$

- MER2-501-79U3M/C(-L)

When the pixel format is Mono8 or BayerRG8, the row period (unit: μs):

$$T_{row} = \frac{236}{40} = 5.9$$

When the pixel format is Mono12 or BayerRG12, the row period (unit: μs):

$$T_{row} = \frac{236 \times 2}{40} = 11.8$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 38) \times T_{row}$$

- MER2-502-79U3M/C(-L) / MER2-502-79U3M POL

When the pixel format is Mono8 or BayerRG8, the row period (unit: μs):

$$T_{row} = \frac{240}{40} = 6$$

When the pixel format is Mono10 or BayerRG10, the row period (unit: μs):

$$T_{row} = \frac{240\times2}{40} = 12$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 38) \times T_{row}$$

- MER2-503-36U3M/C(-L) / MER2-503-36U3M POL

The row period (unit: μs):

$$T_{row} = \frac{532}{40} = 13.3$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 32) \times T_{row}$$

- MER2-510-36U3M/C(-L)

The row period (unit: μs):

$$T_{row} = \frac{532}{40} = 13.3$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 38) \times T_{row}$$

- MER2-630-60U3M/C(-L/-W90/-W90-S90)

When the pixel format is Mono8 or BayerRG8, the row period (unit: μs):

$$T_{row} = \frac{420}{54} = 7.78$$

When the pixel format is Mono10 or BayerRG10, the row period (unit: μs):

$$T_{row} = \frac{420\times2}{54} = 15.56$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 78) \times T_{row}$$

- MER2-1220-32U3M/C(-L/-W90/-W90-S90)

When the pixel format is Mono8 or BayerRG8, the row period (unit: μs):

$$T_{row} = \frac{720}{72} = 10$$

When the pixel format is Mono12 or BayerRG12, the row period (unit: μs):

$$T_{row} = \frac{720 \times 2}{72} = 20$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 38) \times T_{row}$$

- MER2-2000-19U3M/C(-L/-W90/-W90-S90)

When the pixel format is Mono8 or BayerRG8, the row period (unit: μs):

$$T_{row} = \frac{900}{72} = 12.5$$

When the pixel format is Mono12 or BayerRG12, the row period (unit: μs):

$$T_{row} = \frac{900 \times 2}{72} = 25$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 38) \times T_{row}$$

- MER2-2002-20U3M/C(-L)

When the pixel format is Mono8 or BayerGR10, the row period (unit: μs):

$$T_{row} = \frac{2135}{171.67} = 12.4$$

When the pixel format is Mono10 or BayerGR10, the row period (unit: μs):

$$T_{row} = \frac{2135 \times 2}{171.67} = 24.8$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 20) \times T_{row}$$

- MER2-041-608U3M/C(-L)-HS

When the sensor bit depth is BPP8, the row period (unit: μs):

$$T_{row} = \frac{113}{40} = 2.825$$

When the sensor bit depth is BPP10, the row period (unit: μs):

$$T_{row} = \frac{140}{40} = 3.5$$

When the sensor bit depth is BPP12, the row period (unit: μs):

$$T_{row} = \frac{183}{40} = 4.575$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 42) \times T_{row}$$

- MER2-160-249U3M/C(-L)-HS

When the sensor bit depth is BPP8, the row period (unit: μs):

$$T_{row} = \frac{143}{40} = 3.575$$

When the sensor bit depth is BPP10 and the pixel format is Mono8 or BayerRG8, the row period (unit: μs):

$$T_{row} = \frac{157}{40} = 3.925$$

When the sensor bit depth is BPP10 and the pixel format is Mono10 or BayerRG10, the row period (unit: μs):

$$T_{row} = \frac{314}{40} = 7.85$$

When the sensor bit depth is BPP12, the row period (unit: μs):

$$T_{row} = \frac{314}{40} = 7.85$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 42) \times T_{row}$$

- MER2-301-125U3M/C(-L)-HS

When the sensor bit depth is BPP8, the row period (unit: μs):

$$T_{row} = \frac{168}{40} = 4.2$$

When the sensor bit depth is BPP10 and the pixel format is Mono8 or BayerRG8, the row period (unit: μs):

$$T_{row} = \frac{203}{40} = 5.075$$

When the sensor bit depth is BPP10 and the pixel format is Mono10 or BayerRG10, the row period (unit: μs):

$$T_{row} = \frac{406}{40} = 10.15$$

When the sensor bit depth is BPP12, the row period (unit: μs):

$$T_{row} = \frac{406}{40} = 10.15$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 38) \times T_{row}$$

- MER2-502-79U3M/C(-L)-HS / MER2-502-79U3M-HS POL

When the pixel format is Mono8 or BayerRG8, the row period (unit: μs):

$$T_{row} = \frac{198}{40} = 4.95$$

When the pixel format is Mono10 or BayerRG10, the row period (unit: μs):

$$T_{row} = \frac{396}{40} = 9.9$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 38) \times T_{row}$$

- MER2-041-608U3M/C(-L)-HS-6P

When the sensor bit depth is BPP8, the row period (unit: μs):

$$T_{row} = \frac{113}{40} = 2.825$$

When the sensor bit depth is BPP10, the row period (unit: μs):

$$T_{row} = \frac{140}{40} = 3.5$$

When the sensor bit depth is BPP12, the row period (unit: μs):

$$T_{row} = \frac{183}{40} = 4.575$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 42) \times T_{row}$$

- MER2-160-249U3M/C(-L)-HS-6P

When the sensor bit depth is BPP8, the row period (unit: μs):

$$T_{row} = \frac{143}{40} = 3.575$$

When the sensor bit depth is BPP10 and the pixel format is Mono8 or BayerRG8, the row period (unit: μs):

$$T_{row} = \frac{157}{40} = 3.925$$

When the sensor bit depth is BPP10 and the pixel format is Mono10 or BayerRG10, the row period (unit: μs):

$$T_{row} = \frac{314}{40} = 7.85$$

When the sensor bit depth is BPP12, the row period (unit: μs):

$$T_{row} = \frac{314}{40} = 7.85$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 42) \times T_{row}$$

- ME2S-560-70U3M/C

When the pixel format is Mono8 or BayerGB8, the row period (unit: μs):

$$T_{row} = \frac{3 \times 152}{75} = 6.08$$

When the pixel format is Mono12 or BayerGB12, the row period (unit: μs):

$$T_{row} = \frac{3 \times 304}{75} = 12.16$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 15) \times T_{row}$$

- ME2S-1260-28U3M/C

When the pixel format is Mono8 or BayerRG8, the row period (unit: μs):

$$T_{row} = \frac{736}{64} = 11.5$$

When the pixel format is Mono12 or BayerRG12, the row period (unit: μs):

$$T_{row} = \frac{1472}{64} = 23$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 22) \times T_{row}$$

- ME2S-1610-24U3M/C

When the pixel format is Mono8 or BayerRG8, the row period (unit: μs):

$$T_{row} = \frac{386}{40} = 9.65$$

When the pixel format is Mono10/Mono12 or BayerRG10/BayerRG12, the row period (unit: μs):

$$T_{row} = \frac{696}{40} = 17.4$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 110) \times T_{row}$$

- ME2S-2020-19U3M/C

When the pixel format is Mono8 or BayerRG8, the row period (unit: μs):

$$T_{row} = \frac{332}{40} = 8.3$$

When the pixel format is Mono10/Mono12 or BayerRG10/BayerRG12, the row period (unit: μs):

$$T_{row} = \frac{600}{40} = 15$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 110) \times T_{row}$$

- ME2S-2440-16U3M/C

When the pixel format is Mono8 or BayerRG8, the row period (unit: μs):

$$T_{row} = \frac{386}{40} = 9.65$$

When the pixel format is Mono10/Mono12 or BayerRG10/BayerRG12, the row period (unit: μs):

$$T_{row} = \frac{696}{40} = 17.4$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 110) \times T_{row}$$

- ME2S-2560-15U3M/C

When the pixel format is Mono8 or BayerRG8, the row period (unit: μs):

$$T_{row} = \frac{386}{40} = 9.65$$

When the pixel format is Mono10/Mono12 or BayerRG10/BayerRG12, the row period (unit: μs):

$$T_{row} = \frac{696}{40} = 17.4$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 110) \times T_{row}$$

- ME2S-138-136U3M-SWIR

When the sensor bit depth is BPP8, the row period (unit: μs):

$$T_{row} = \frac{277}{40} = 6.925$$

When the sensor bit depth is BPP10, the row period (unit: μs):

$$T_{row} = \frac{300}{40} = 7.5$$

When the sensor bit depth is BPP12, the row period (unit: μs):

$$T_{row} = \frac{524}{40} = 13.1$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 36) \times T_{row}$$

- ME2S-138-232U3M-SWIR

When the sensor bit depth is BPP8, the row period (unit: μs):

$$T_{row} = \frac{162}{40} = 4.05$$

When the sensor bit depth is BPP10, the row period (unit: μs):

$$T_{row} = \frac{174}{40} = 4.35$$

When the sensor bit depth is BPP12, the row period (unit: μs):

$$T_{row} = \frac{300}{40} = 7.5$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 36) \times T_{row}$$

- ME2P-170-210U3M/C

When the pixel format is Mono8 or BayerRG8, the row period (unit: μs):

$$T_{row} = \frac{156}{40} = 3.9$$

When the pixel format is Mono10 / Mono12 / BayerRG10 / BayerRG12, the row period (unit: μs):

$$T_{row} = \frac{312}{40} = 7.8$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 112) \times T_{row}$$

- ME2P-530-72U3M NIR / ME2P-530-72U3C

When the pixel format is Mono8 or BayerGB8, the row period (unit: μs):

$$T_{row} = \frac{Width/8+104}{64}$$

Width: The image width. When the maximum image width is 2592, the row period (unit: μs):

$$T_{row} = \frac{2592/8+104}{64} = 6.688$$

When the pixel format is Mono10 or BayerGB10, the row period (unit: μs):

$$T_{row} = \frac{Width/8+259}{64}$$

Width: The image width. When the maximum image width is 2592, the row period (unit: μs):

$$T_{row} = \frac{2592/8+259}{64} = 9.11$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 11) \times T_{row} + 112$$

- ME2P-560-36U3M/C

When the pixel format is Mono8 or BayerGB8, the row period (unit: μs):

$$T_{row} = \frac{5\times152}{60} = 12.67$$

When the pixel format is Mono12 or BayerGB12, the row period (unit: μs):

$$T_{row} = \frac{5\times304}{60} = 25.33$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 15) \times T_{row}$$

- ME2P-883-42U3M/C

When the pixel format is Mono8 or BayerRG8, the row period (unit: μs):

$$T_{row} = \frac{432}{40} = 10.8$$

When the pixel format is Mono12 or BayerRG12, the row period (unit: μs):

$$T_{row} = \frac{432\times2}{40} = 21.6$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 34) \times T_{row}$$

- ME2P-900-43U3M/C

When the pixel format is Mono8 or BayerGB8, the row period (unit: μs):

$$T_{row} = \frac{4\times152}{60} = 10.13$$

When the pixel format is Mono12 or BayerGB12, the row period (unit: μs):

$$T_{row} = \frac{4\times304}{60} = 20.27$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 15) \times T_{row}$$

- ME2P-1230-23U3M/C

When the pixel format is BayerRG8, the row period (unit: μs):

$$T_{row} = \frac{560}{40} = 14$$

When the pixel format is BayerRG12, the row period (unit: μs):

$$T_{row} = \frac{560\times2}{40} = 28$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 34) \times T_{row}$$

- ME2P-1231-32U3M/C / ME2P-1231-32U3M POL

When the pixel format is Mono8 or BayerRG8, the row period (unit: μs):

$$T_{row} = \frac{376}{40} = 9.4$$

When the pixel format is Mono10 / Mono12 / BayerRG10 / BayerRG12, the row period (unit: μs):

$$T_{row} = \frac{376\times2}{40} = 18.8$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 54) \times T_{row}$$

- ME2P-1840-21U3M/C

When the pixel format is Mono8 or BayerGB8, the row period (unit: μs):

$$T_{row} = \frac{4\times152}{60} = 10.13$$

When the pixel format is Mono12 or BayerGB12, the row period (unit: μs):

$$T_{row}=\frac{4\times304}{60}=20.27$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 15) \times T_{row}$$

- ME2P-2621-15U3M/C \ ME2P-2622-15U3M/C

When the pixel format is Mono8 or BayerGB8, the row period (unit: μs):

$$T_{row} = \frac{48\times124}{60\times8} = 12.4$$

When the pixel format is Mono12 or BayerGB12, the row period (unit: μs):

$$T_{row} = \frac{48\times248}{60\times8} = 24.8$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 16) \times T_{row}$$

- ME2P-2621-15U3M NIR \ ME2P-2622-15U3M NIR

When the pixel format is Mono8, the row period (unit: μs):

$$T_{row} = \frac{48\times124}{60\times8} = 12.4$$

When the pixel format is Mono12, the row period (unit: μs):

$$T_{row} = \frac{48 \times 248}{60 \times 8} = 24.8$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 16) \times T_{row}$$

- ME2P-1230-30U3M/C-HS

When the pixel format is Mono8 or BayerRG8, the row period (unit: μs):

$$T_{row} = \frac{432}{40} = 10.8$$

When the pixel format is Mono12 or BayerRG12, the row period (unit: μs):

$$T_{row} = \frac{432 \times 2}{40} = 21.6$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 34) \times T_{row}$$

- ME2L-042-121U3M/C(-L)

Row period (unit: μs):

$$T_{row} = \frac{540}{37.5} = 14.4$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 30) \times T_{row}$$

- ME2L-161-61U3M/C(-L)

Row period (unit: μs):

$$T_{row} = \frac{552}{37.5} = 14.72$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 30) \times T_{row}$$

- ME2L-203-76U3M/C(-L)

Row period (unit: μs):

$$T_{row} = \frac{446}{37.5} = 11.89$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 25) \times T_{row}$$

- ME2L-204-76U3M/C(-L)-F02

Row period (unit: μs):

$$T_{row} = \frac{446}{37.5} = 11.89$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 25) \times T_{row}$$

- ME2L-505-36U3M/C(-L)

Row period (unit: μs):

$$T_{row} = \frac{510}{37.5} = 13.6$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 96) \times T_{row}$$

- ME2L-830-22U3M/C(-L)

Row period (unit: μs):

$$T_{row} = \frac{768}{37.5} = 20.48$$

The camera acquisition time (unit: μs):

$$T_{acq} = (Height + 48) \times T_{row}$$

8.6. Events

When event notification is set to "on", the camera can generate an "event" and transmit a related event message to the host whenever a specific situation has occurred. For MERCURY2 USB3 Vision camera, the camera can generate and transmit events for the following situations:

- The camera has ended exposure (ExposureEnd)
- An image block is discarded (BlockDiscard)
- The trigger signal overflow (FrameStartOvertrigger)
- The image frame block is not empty (BlockNotEmpty)
- The burst trigger signal overflow (FrameBurstStartOvertrigger)
- The trigger signal wait (FrameStartWait)
- The burst trigger signal wait (FrameBurstStartWait)

Every event has a corresponding enable status, and in default all the events' enable status are disable.

When using the event feature, you need to enable the corresponding event. The effective information contained in each event is shown in Table 8-6:

No.	Event Type	Information
1	ExposureEnd Event	Event ID
		Frame ID
		Timestamp
2	BlockDiscard Event	Event ID
		Frame ID
		Timestamp
3	FrameStartOvertrigger Event	Event ID
		Frame ID
		Timestamp
4	BlockNotEmpty Event	Event ID
		Frame ID
		Timestamp
5	FrameBurstStartOvertrigger Event	Event ID
		Frame ID
		Timestamp
6	FrameStartWait Event	Event ID
		Frame ID
		Timestamp
7	FrameBurstStartWait Event	Event ID
		Frame ID
		Timestamp

Table 8-6 The effective information of each event

Among them: the timestamp is the time when the event occurs, and the timer starts when the camera is powered on or reset. The bit width of the timestamp is 64 bits, and the unit is ns.

8.6.1. ExposureEnd Event

If the ExposureEnd Event is enabled, when the camera's sensor has been exposed, the camera sends out an ExposureEnd Event to the host, indicating that the exposure has been completed.

8.6.2. BlockDiscard Event

When the average bandwidth of the write-in data is greater than the average bandwidth of the read-out data, the frame buffer may overflow. If the frame buffer is full and the camera continue to write image data to it, then the new data will overwrite the previous image data which has been in the frame buffer. At this moment, the camera sends a BlockDiscard event to the host, indicating that image discard event has occurred. So, when you read the next frame of image, the image is not continuous.

8.6.3. BlockNotEmpty Event

When the average bandwidth of the write-in data is greater than the average bandwidth of the readout data, if the frame buffer is not full, and there has image frame data in the frame buffer which has not been send out completely, then before the new image frame is written to the frame buffer, the camera will send a BlockNotEmpty event to the host, indicating that the previous image has not been send out completely when the new image is written in the frame buffer.

8.6.4. FrameStartOvertrigger Event

When the camera receives the FrameTrigger hardware trigger signal or software trigger signal, if the front-end sensor is exposing, it will not be able to respond to the new FrameTrigger signal, then the camera will send a FrameStartOvertrigger event to the host. Note that if multiple FrameTrigger signals are received within one frame acquisition period, the camera will send the corresponding number of FrameStartOvertrigger events.

8.6.5. FrameBurstStartOvertrigger Event

When the camera is in FrameBurstStart trigger mode, when it receives an AcquisitionTrigger hardware trigger or software trigger signal, if the front-end sensor is exposing, it will not be able to respond to the new AcquisitionTrigger signal, and the camera will send a FrameBurstStartOvertrigger event to the host. Note that the camera will send the corresponding number of FrameBurstStartOvertrigger events if it receives multiple AcquisitionTrigger signals during the acquisition period of one frame of image.

8.6.6. FrameStartWait Event

When the camera is in FrameTrigger mode, the camera starts acquiring images, and if it does not receive the FrameTrigger signal, the camera will send a FrameStartWait event to the host.

8.6.7. FrameBurstStartWait Event

When the camera is in the AcquisitionTrigger mode, the camera starts acquiring images. If the camera does not receive the AcquisitionTrigger signal, the camera sends a FrameBurstStartWait event to the host. Note that if the FrameTrigger mode is set to on simultaneously with the AcquisitionTrigger mode, the FrameBurstStartWait event will be sent first. When the camera receives an AcquisitionTrigger signal, it will send a FrameBurstStartWait event.

8.7. UART Port

The camera supports the TTL serial port function, and the Tx/Rx and GPIO pins are multiplexed. Through the software API interface, it can be configured as either the GPIO or the serial port. After being configured as a serial port, the serial port commands can be transmitted to the GPIO pin of the camera through the API interface to control other serial port devices.

The baud rate supported by the serial port is 9600, 19200, 38400, 76800, 115200, and the data bit width is 8bit, the maximum length for a single transmission or reception is 1004 bytes. For more details or the sample code, please contact our technical support.

The wiring diagram of the camera and external serial port device is shown below. Line3 can be configured as Tx or Rx, the same as Line2. When Line3 is configured as Tx, it should be connected to the Rx of the UART module; At this time, Line2 should be configured as Rx and connected to the Tx of the UART module.

Due to the open drain output of Line2/Line3, it is necessary to supply power to the UART module at +3.3V/+5V for normal communication.

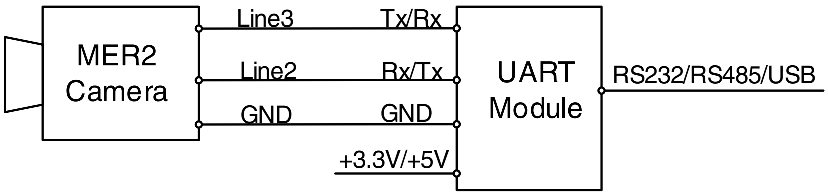


Figure 8-101 The wiring diagram of the camera and external serial port device

8.8. Sequencer

The Sequencer feature allows you to define sets of parameter settings and apply them to a sequence of image acquisitions. As the camera acquires images, it applies one sequence set after the other, as shown in Figure 8-102.

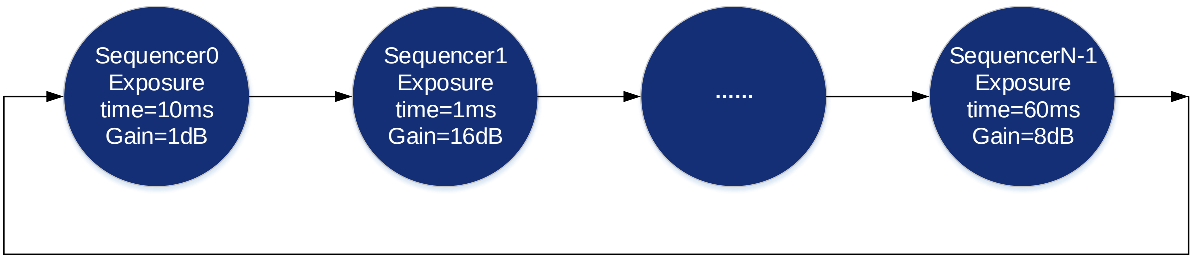


Figure 8-102 Sequencer feature schematic diagram

8.8.1. Relevant Parameters

[SequencerMode] Set the parameter to "On", enable the sequencer. Set the parameter to "Off", disable the sequencer. When enabled, the sequencer controls image acquisitions, switch to next sequence set after each image is acquired. When disabled, the sequencer is not controlling image acquisitions and cannot switch parameters.

[SequencerConfigurationMode] Set the parameter to "On", "SequencerSetSave" and "SequencerSetLoad" are enabled. Set the parameter to "Off", "SequencerSetSave" and "SequencerSetLoad" are disabled and parameters cannot be saved to the sequence sets.

[SequencerFeatureSelector] Configure the feature that support sequence, like ExposureTime, Gain.

[SequencerFeatureEnabled] Set the parameter to "true", the feature in "SequencerFeatureSelector" is supported sequence, currently only true are supported and cannot be changed.

[SequencerSetSelector] Set the sequence set number. The range is determined by the camera model.

[SequencerSetSave] Save parameters to the sequence set in "SequencerSetSelector"

[SequencerSetLoad] Click "SequencerSetLoad", the values of sequence set parameters are overwritten and replaced by the values stored in the selected sequence set.

[SequencerSetActive] When "SequencerMode" is set to "On", displays the sequence set number currently in use, as shown below. The advance from one sequence set to the next occurs automatically as FrameStart trigger signals are received. When "SequencerMode" is set to "Off", displays "Not Available".

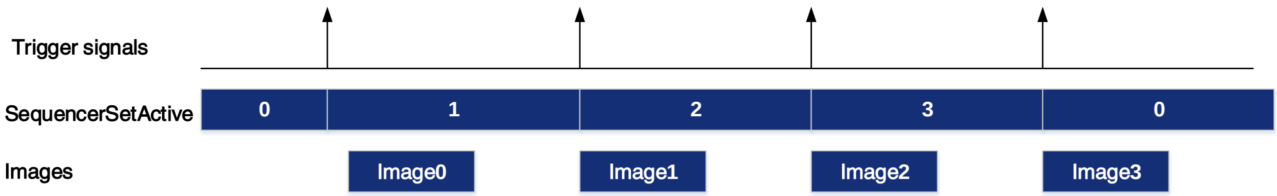


Figure 8-103 Timing diagram

[SequencerPathSelector] Not currently supported, the set value is fixed to 0.

[SequencerSetNext] The "SequencerSetSelector" sets number to which the next sequence set jumps. For example, if "SequencerSetSelector" is set to 1 and "SequencerSetNext" is set to 2, then after the camera uses the parameters to acquire an image, the sequence set will be switched to sequence set 2. Only sequential jump is supported, "SequencerSetSelector" is set to N, and then "SequencerSetNext" can only be set to N+1 or 0, and the maximum value of N+1 is "the maximum number of sequence sets supported-1". If the maximum number of sequences of cameras is 4, the maximum value of N+1 is 3.

[SequencerTriggerSource] The condition for the sequencer to start running, FrameStart only supported. Each time an image is acquired, the sequence switches to the next sequence set.

8.8.2. User Guide

- Set sequence parameters

1) Set the "SequencerMode" to "Off" and the "SequencerConfigurationMode" to "On".

2) Set the "SequencerSetSelector" parameter.

3) Click "SequencerSetLoad", the values of sequence set parameters are overwritten and replaced by the values stored in the selected sequence set.

4) Set the sequence set parameters: ExposureTime, Gain, Gamma, FFC coefficient number, etc.

5) Click "SequencerSetSave".

- Change the number of sequence sets used

By default, sequence set are set as 0->1->2->3...->N−1, but in some cases we may want the sequence set to run in the order 0->1->2->3->0->1->2->3, in which case this order can be achieved by "SequencerSetNext".

For example, we want the sequence sets to run in the order 0->1->2->0->1->2, the setting is as follows:

1) Set the "SequencerSetSelector" to 2.

2) Set the "SequencerSetNext" to 0.

- When acquisition is stopped, the sequence set number is cleared to 0, and when acquisition is restarted, the sequence set number starts from 0 to perform the sequencer.

- Before "SequencerMode" set to "On", the auto gain, auto exposure and auto white balance functions must be set to "Off".

- Sequencer Gain only supports digital gain, not analog gain.

1) When "SequencerConfigurationMode" is switched from "Off" to "On", the current value of "GainSelector" is automatically changed to digital gain.

2) When "SequencerMode" is switched from "Off" to "On", the current value of "GainSelector" is automatically changed to digital gain.

3) When both the "SequencerMode" and "SequencerConfigurationMode" are "Off", the "GainSelector" function will be restored to be settable, AnalogAll and DigtalAll are selectable. During auto gain adjustment, only analog gain is adjusted, digital gain is not adjusted but the setting value is valid.

- Sequencer parameters can be saved in user set.

- Sequencer parameters do not support remove parameter limits

8.8.3. Sequence support

Model		Max. sequence sets number	Sequence support function
MER2-041-528U3M/C(-L) MER2-060-642U3M(-L) MER2-160-227U3M/C(-L) MER2-230-168U3M/C(-L) MER2-280-139U3M/C(-L) MER2-301-125U3M/C(-L) MER2-303-107U3M/C(-L) MER2-304-56U3M/C(-L) MER2-501-79U3M/C(-L) MER2-502-79U3M/C(-L)	MER2-502-79U3M POL MER2-510-36U3M/C(-L) MER2-1220-32U3M/C(-L) ME2P-170-210U3M/C ME2P-1230-23U3M/C ME2P-1231-32U3M/C ME2P-1231-32U3M POL ME2S-138-136U3M-SWIR ME2S-138-232U3M-SWIR	8	ExposureTime, Gain

Table 8-7 Camera model sequence supported items

9. Software Tool

9.1. LUT Create Tool

9.1.1. GUI

LUT Create Tool, which supports all series of DAHENG IMAGING cameras. This plugin is integrated into GalaxyView.exe. After opening the device that you want to operate through this software, you can open LUT Create Tool from the menu bar plugin list. With the plugin you can achieve the following functions:

1) Adjust the image Gamma, brightness, and contrast.

2) Read the saved LUT from device.

3) Write the adjusted LUT to device.

4) Read the saved LUT from LUT/CSV file.

5) Save the adjusted LUT to file.

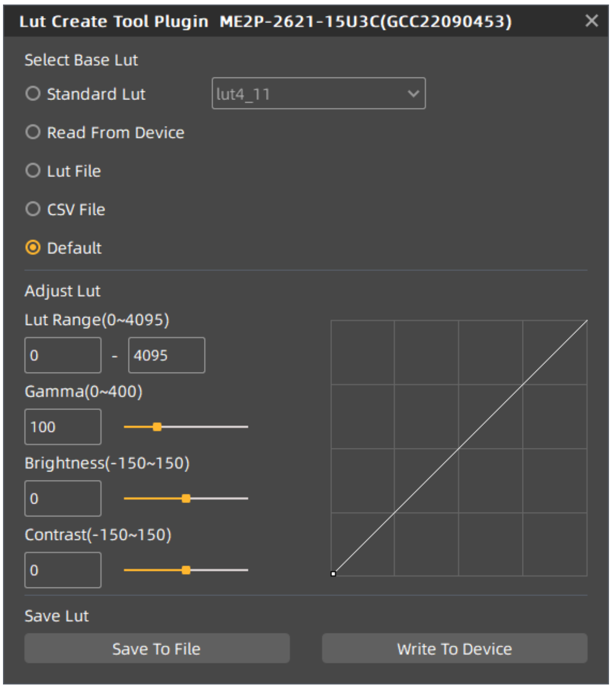


Figure 9-1 The GUI of LUT Create Tool

After opening the device and LUT Create Tool through GalaxyView.exe, the initial GUI is shown in Figure 9-1. The layout and function description of widgets are as follows:

[Select Base LUT] Include Standard LUT, Read From Device, LUT File, CSV File and Default options. Among them, standard LUT is eight groups of factory standard LUTs. Read from device is the LUT that can be read from device. LUT/CSV file can read the saved values. Default mode is the camera factory default value.

[Adjust LUT] Adjust the LUT range, Gamma, brightness, and contrast to add effects on base LUT.

[Save LUT] Write the currently generated LUT to device or save to LUT/CSV file.

[Polyline Drawing Area] Represent the currently generated LUT in a curve form.

9.1.2. User Guide

9.1.2.1. User Case

After you select "Select Base LUT" and adjust the LUT parameter to a satisfactory effect, if you want to save the currently set parameters and you want to restore the parameters after the camera is powered on again, you need to select "Write To Device". The LUT parameter will be written to the UserSet0. After the device is powered on again, select the "Read From Device" in the "Select Base LUT" to load the UserSet0 and restore the parameter value.

If the device does not support read/write LUT, or does not support LUT to be used on other terminal devices after adjusting LUT effect through this terminal, then you can use the "Save To File" function. After adjusting LUT, select "Save To File" and choose the save format as .lut. Then select the "LUT File" in "Select Base LUT" again and select the saved LUT file to restore the parameters. If you copy the file to another terminal and read it, you can still restore the parameters.

9.1.2.2. Select Base LUT

1. Standard LUT

When selecting Standard LUT in "Select Base LUT", the drop-down list box is enabled, which contains eight sets of optional standard LUT, as shown in Figure 9-9. These eight sets of values are factory set, which can achieve the optimal image effect. When you choose different standard LUT, the polyline and image effects change. You can modify the LUT range, Gamma, brightness, contrast values to add image effects until you are most satisfied.

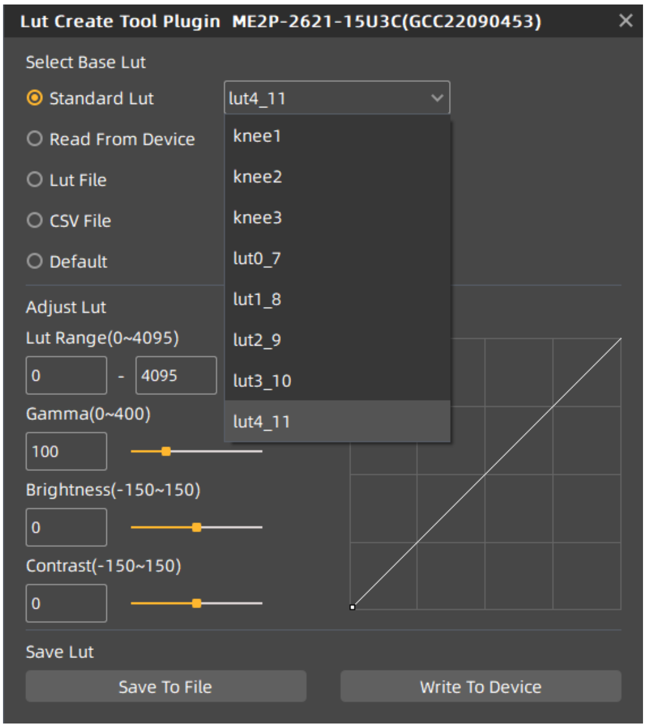


Figure 9-2 Standard LUT

2. Read From device

After selecting Read From Device, UserSet0 will be loaded automatically, and then load the LUT saved by the device. If the device supports LUTEnable function, it will automatically set LUTEnable to true to display the image effect in real time, the GUI is as shown in Figure 9-3.

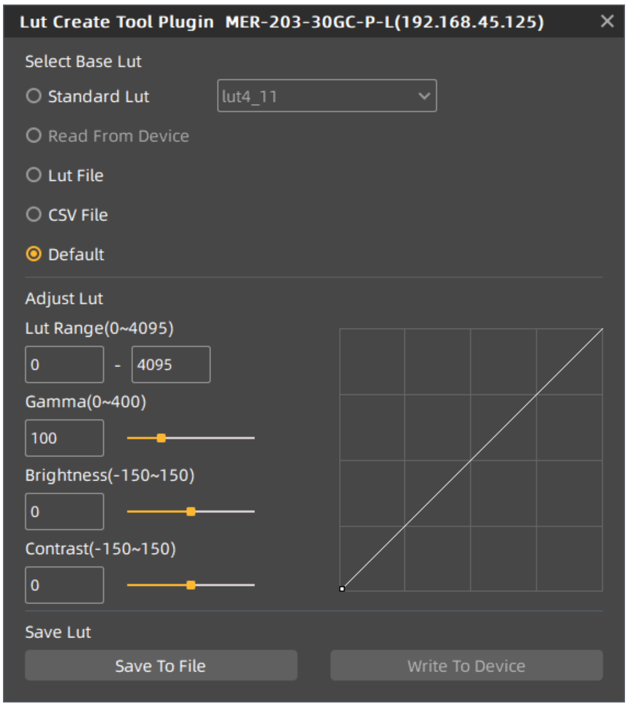


Figure 9-3 Do not support "Read From Device"

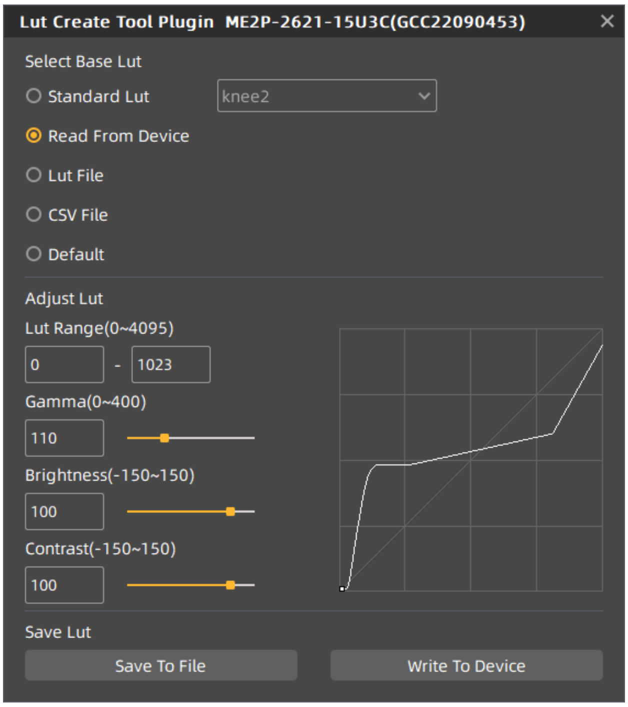


Figure 9-4 Select "Read From Device"

When selecting "Read From Device", the polyline graph and image effects are updated to the lookup table in the device. When selecting the Standard LUT or Default and selecting "Write To Device", then when reading, the written parameters will be updated to the GUI. For example, Standard LUT selects knee2, LUT Range input 0-1023, Gamma input 110, brightness input 100, Contrast input 100, and the GUI after selecting "Write To Device" is shown in Figure 9-4.

3. LUT file

After selecting the LUT file, a dialog box for selecting the file will pop up. You can select the file in the format of .lut, and update the polyline diagram and image acquisition effect of the device. If you select Standard LUT or Default to adjust and save LUT, the widget interface will update the parameters stored when saving LUT (the updated parameter values include LUT range, Gamma, brightness, contrast, and the values selected by the standard LUT drop-down box).

4. CSV file

After selecting CSV file, a dialog box for selecting the file will pop up. You can select the file in the format of .csv, and update the polyline diagram and image acquisition effect of the device. After selecting CSV file, all widgets of Adjust LUT are disabled and unadjustable, as shown in Figure 9-5.

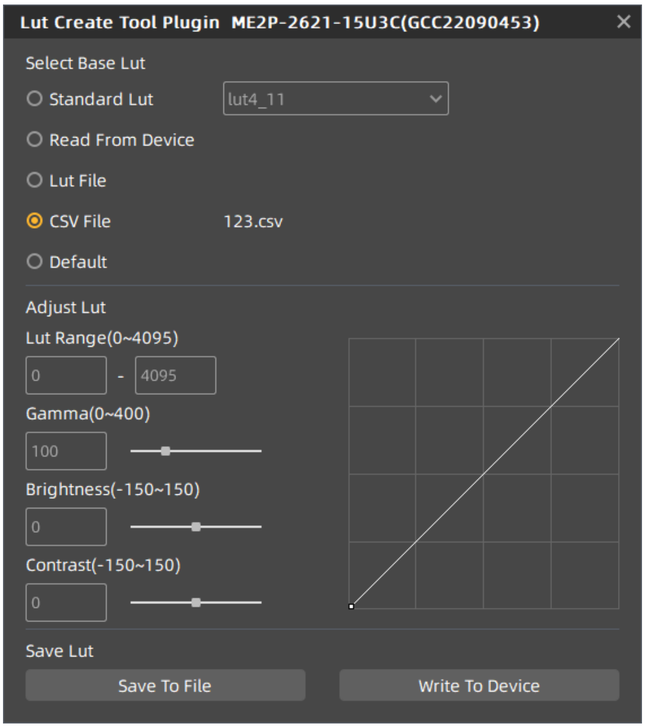


Figure 9-5 Select CSV file

CSV file can be manually modified by users. Currently, .csv storage format saves decimal number of every four bytes to the first cell of each line in the file, and the maximum value of the number in each cell is 4095, a total of 4096 lines. The polyline graph of the GUI updates the curve according to the number of the first line of every 16 lines. Failure to follow the format when manually modifying will result in failure to read the file.

5. Default

The Default option is the LUT data when the device is shipped from the factory, and is the initial value in each situation. If there is an error in other situation, it will automatically switch to the default. The default polyline graph is diagonal.

9.1.2.3. Auto Create LUT

There are five sets of parameters in Auto Create LUT, the maximum LUT range (default value 4095, range 0~4095), minimum value (default value 0, range 0~4032), Gamma (default value 100, range 0~400), brightness (default value 0, range -150~150), contrast (default value 0, range -150~150), where the difference between the maximum and minimum values of the LUT range needs to be greater than or equal to 63.

After selecting the Select Base LUT, when the above parameters are modified, the generated LUT will be written to the device Flash in real time. At this time, the "Write To Device" is not selected. After the device is powered off and restarted, the modified parameters will be lost. The generated LUT cannot be restored by "Read From Device".

If the Select Base LUT is selected as Default or Standard LUT, then adjusting the parameter values in the LUT group to generate LUT and saving the .lut file will save the parameter values together in the file. Reading the file again will restore the saved case. If written to the device, the cameras will save and restore the parameter.

9.1.2.4. Save LUT

The group contains two widgets: Save To File and Write To Device.

1. When selecting "Save To File", the current LUT data can be saved to the file. The saved file contains two formats: lut and csv, The save type can be changed when saving the file. The default save path is ".\resource\gxplugins\LookUpTable\LUT12", which is the directory where the GalaxyView.exe is installed.

2. When "Write To Device" is selected, the current LUT data is written to UserSet0, and UserSetDefault is modified to UserSet0. UserSet0 will be loaded when reading from the device again.

9.1.2.5. Read LUT

There are two ways to read the .lut file saved by the plugin and set it into the camera:

1. Using the plugin: After selecting the LUT file, a dialog box for selecting the file will pop up. You can select the lookup table file (xxx.lut). Clicking the "Write To Device" to set the LUT file data into the camera.

2. Using the API interface: Read the .lut file through the ReadLutFile interface in the GxIAPI library and DxImageProc library and parse it into lookup table format that can be set to the appropriate camera. The specific steps are as follows:

a) Get the length of the Lookup Table.

b) Apply for the LUT Buffer resource of the corresponding size according to the LUT length.

c) Read the LUT file (xxx.lut), and get the LUT Buffer data.

d) Set the LUT Buffer data into the camera. (Make sure the LUTEnable is true).

e) Save the current LUT data to UserSet0, and synchronously set the UserSetDefault to UserSet0. When reading from the device again, the camera will load the lookup table data.

The API interface supports C/C++/C#. For specific about the interface and example programs, please refer to relevant section of "C SDK Programming Reference Manual", "C++ SDK Programming Reference Manual" and "DotNET SDK Programming Reference Manual".

9.1.3. Precautions

9.1.3.1. Read From Device

When reading from device, UserSet0 will be loaded, which will cause the previously modified device feature information to be lost. Therefore, the information should be saved in time before reading from device.

9.1.3.2. Write To Device

In order to ensure that the device will restore the effect before power off after the device is power-on again. When writing to device, it will set the parameter set to UserSet0 and set the UserSetDefault to UserSet0.

If you do not want to restore the case and the LUT in the flash after powering off and restarting the device, please use the "Write To Device" function with caution.

9.1.3.3. Directory Structure

When reading/writing LUT and Auto Creat LUT, you need to rely on some files in the installation package directory, so do not arbitrarily change the installation package directory structure to avoid read/write failure.

9.2. Flat Field Correction Plugin

ShadingCorrectionTool.plx is the companion software for DAHENG IMAGING industry camera. The plugin is integrated into GalaxyView.exe. After opening the device through this software, open the FFC plugin from the menu bar plugin list. Using the plugin, you can achieve the following functions:

1) Execute FFC on the current device.
2) Obtain the FFC factor that has been validated from the device.
3) Write the prepared FFC factor to the device to prevent the factor from being lost after the device is powered off.
4) Load the saved FFC factor from the file.
5) Save the prepared FFC factor to the file.

9.2.1. GUI

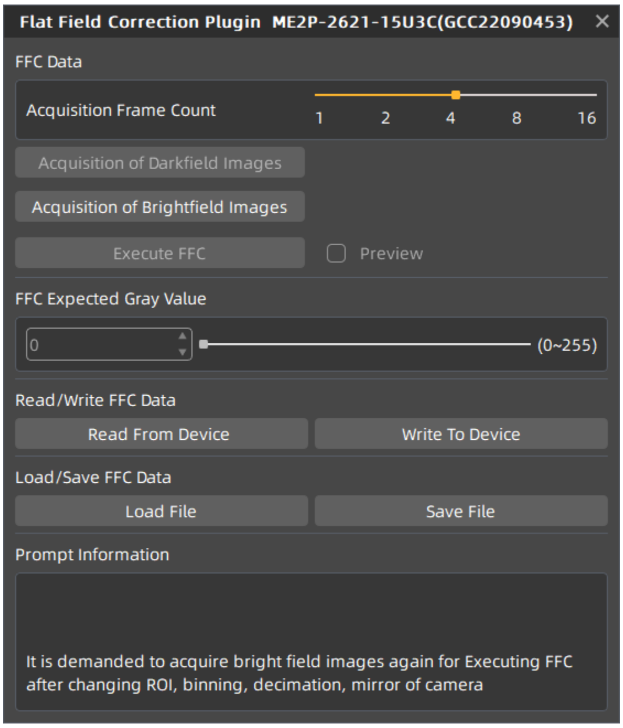


Figure 9-6 Flat field plugin GUI

After opening the device through GalaxyView.exe and opening the FFC plugin, the initial state of the GUI is shown in Figure 9-6. The widgets layout and function description are as follows:

No.	Widget	Function
1	Acquisition Frame Count	The number of images acquired for the acquisition of bright field images
2	Acquisition of Bright Field Images	Acquire a certain number of bright field images. Necessary operation
3	Execute FFC	Calculate the FFC factor and make it Immediate effect
4	Preview	Check the effects before and after the FFC
		Enable or disable FFC preview
5	Read from Device	If the device had executed FFC and the correction factor have been written to the device, the next time the camera is powered on, the FFC factor can be read directly from the device and take effect in real time
6	Write to Device	Write the calculated FFC factor to the device to prevent factors loss when the device is powered off
7	Load File	Load the FFC factor from the file and make it immediate effect
8	Save File	Save the calculated FFC factor to a file. When the factor is subsequent used, it can be loaded directly from the file
9	Prompt Information	Prompt the execution status and error message when executing FFC
10	Default prompt message	It is demanded to acquire bright field images again for executing FFC after changing ROI, Binning, Decimation, Mirror of the camera. The prompt message will always be displayed on the GUI

Table 9-1 Function description of the FFC widgets

9.2.2. User Guide

9.2.2.1. FFC Execution Steps

Step1: Set the acquisition frame count. Not necessary operation. You can skip to step 2 directly. For details, please see section 8.4.7.1.

Step2: Before acquiring bright field images, you need align the lens at white paper or the flat fluorescent lamp.

Step3: Start acquiring bright field images. For details on acquiring bright field images, please see section 8.4.7.1.

Step4: Click "Execute FFC" to complete the correction.

Step5: You can view the effect before and after FFC through the preview function.

Step6: You can choose to write the correction factor (including the Acquisition Frame Count) to the device or save it to a file for subsequent use.

9.2.2.2. Acquisition of Bright Field Images

1) When the device is in the stop acquisition mode, when you click "Acquisition of Brightfield Images", the image will be displayed in the GalaxyView acquisition GUI.

2) When the device is in the acquisition mode, click "Acquisition of Brightfield image" to complete the bright field image acquisition.

3) The number of bright field images acquired is related to the Acquisition Frame Count. For example, if the number of Acquisition Frame Count is set to 4, when you click "Acquiring of Brightfield Image", 4 images will be acquired for FFC calculation.

4) If the brightness of the acquired bright field image is less than 20, the prompt box will show "The bright field image is too dark, it will affect the flat field correction effect, it is recommended to adjust the brightness of the image in the range of 20-250" and then re-acquiring the bright field image.

5) If the brightness of the acquired bright field image is greater than 250, the prompt box will show "The bright field image is too bright, it will affect the flat field correction effect, it is recommended to adjust the brightness of the image in the range of 20-250" and then re-acquiring the bright field image.

1) The larger the "Acquisition Frame Count" is set, the longer it will take to acquire the bright field images.

2) When the color camera is acquiring bright field images, if white balance has not been done, the image after FFC is an image with white balance effect.

9.2.2.3. Execute FFC

1) "Execute FFC" is enabled after the bright field image acquisition is completed.

2) Click "Execute FFC" to calculate the FFC factor and set it to the device to take effect in real time. If the factor is not written to the device, it will be lost when the device is powered down. And the FFC needs to be redone.

3) When the FFC is completed, the preview widget takes effect. The preview function can be used to check the effects before and after the FFC.

9.2.2.4. Read FFC Data from Device / Write FFC Data to Device

1) When reading FFC data from the device or writing FFC data to the device, the FFC is enabled by default. After the read from the device is successful, the FFC takes effect in real time.

2) When writing to the device, the user set will be saved and the startup user set will be set to userset0.

9.2.2.5. Load FFC Data from File / Save FFC Data to File

1) When loading FFC data from file or saving FFC data to file, the FFC is enabled by default. After the read from the device is successful, the FFC takes effect in real time.

2) When loading FFC data from file or saving FFC data to file, the default file path is: under the installation path (*\GalaxySDK\Demo\Win64\resource\gxplugins\FlatFieldCorrection).

When loading from a file, only files with a format of .ffc can be opened.

9.2.3. Precautions

9.2.3.1. FFC is not Supported

When the device does not support FFC, all widgets of the FFC plugin are disabled. The prompt box indicates that the device does not support FFC. Therefore, the FFC cannot be used for this device.

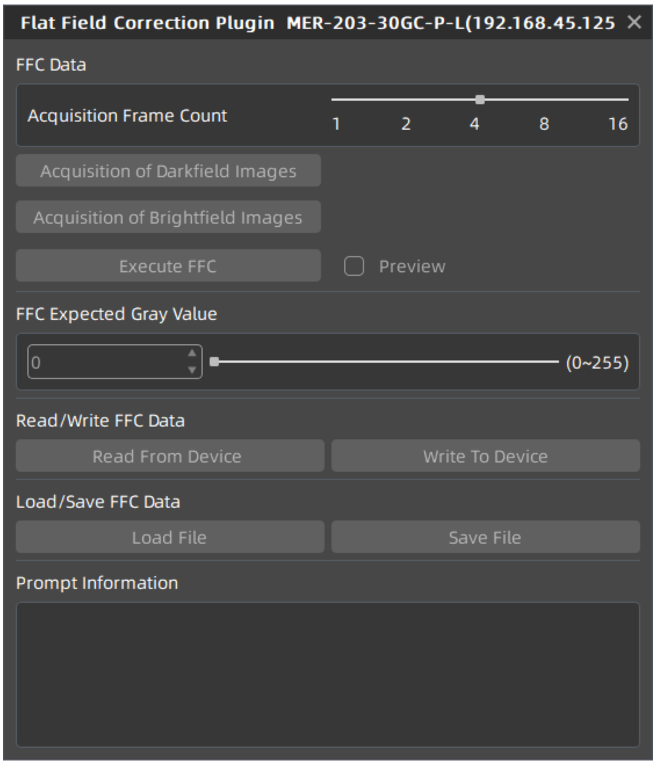


Figure 9-7 The camera does not support FFC

9.2.3.2. Preview

The preview widget is grayed out when acquiring bright field images and cannot be previewed.

9.3. Static Defect Correction Plugin

Static Defect Correction Plugin support all series of DAHENG IMAGING industry camera. The plugin is integrated into GalaxyView.exe. After opening the device through GalaxyView, open the Static Defect Correction plugin from the menu bar plugin list. Using the plugin, you can achieve the following functions:

1) Analyze the defect pixel in the current images of the device, including Bright dark scene and Actual scence.

2) Execute Static Defect Correction on the images.

3) Save the defect pixel information to the device.(The camera which support Static Defect Correction)

4) Save the defect pixel information to the file

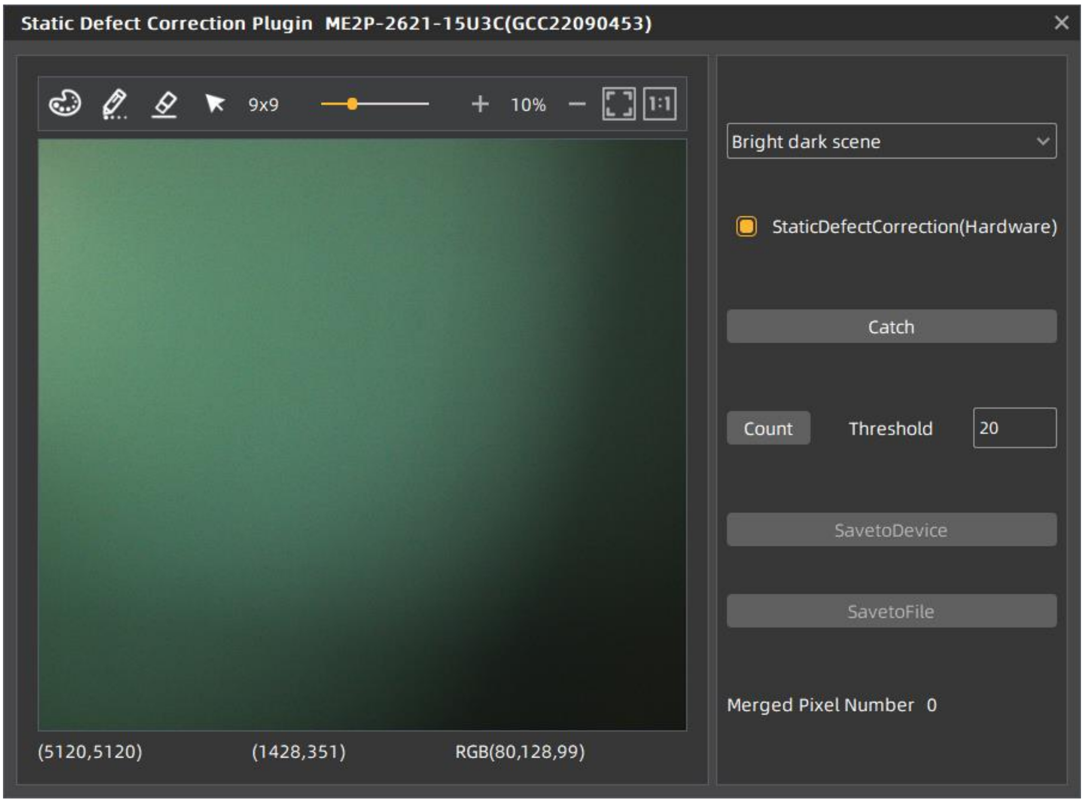


Figure 9-8 Static Defect Correction Plugin

After opening the device through GalaxyView.exe and opening the Static Defect Correction plugin, the initial state of the GUI is shown in Figure 9-8. The plugin layout and function description are as follows:

No.	Widget	Function
1	Catch	Acquisition an image to analyze the location of the defect pixels and noise points
2	Threshold	Set the threshold for defect pixels and noise points judgment
3	Bright dark scene	Count the defect pixels
4	Actual scene	Count the noise points
5	Count	Count the location of the defect pixels and noise points
6	StaticDefectCorrection (Hardware)	Choose whether to perform Static Defect Correction
7	SavetoDevice	Save the defects information to the device
8	SavetoFile	Save the defects information to a file
9	Image display area	Display the image. After counting the defect pixels and noise points, the location of the defect/noise pixels will be marked on the displayed image
10	Merged pixel number	Display the number of defects
11		Change the color of merged pixels

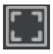
12		Manually mark the defects on the image
13		Erase the original merged pixels on the image
14		Set mouse gestures as arrow
15		Change the size of merged pixels
16		Zoom in
17		Zoom out
18		Adaptive present image
19		Present image 100%

Table 9-2 Function description of the Static Defect Correction plugin

[Image] Capture an image through the catch button and display it in the white area in the middle of the plugin. The captured image is used to analyze the location of the defect pixels /noise points.

[Defect pixel analysis] User determines the range of defect pixels to be processed by setting the threshold and select the type of defect pixels. After clicking the "Count" button, the plugin will analyze the location of the defect pixels /noise points in the current image, and mark the location of the defect pixels on the image as red. The merged pixel number are display in the status bar.

If the current device supports the function of static defect pixel correction, and the merged pixel number is less than the number 8192 that the device supports. The defect pixel information will be written into the FLASH of the device.

[Operation] The Static Defect Correction can be performed by hardware or software. If the current device supports Static Defect Correction and the merged pixel number is less than 8192, hardware is preferred to perform Static Defect Correction, otherwise it can be executed through software. After the user check the Static Defect Correction box, the image displayed on GalaxyView is the image after performing the Static Defect Correction.

"SavetoDevice" button can save the defect pixel information to the FLASH of the device.

"SavetoFile" button can save the defect pixel information to .dp or .csv file.

[Image display area] Display the image and the location of the defect pixels /noise points.

[Status bar] Show the defect pixels number/noise points number/merged pixel number.

9.3.1. Static Defect Correction Steps

1) Click the "Catch" to capture an image. For details, please see section “Acquisition Images”

2) Set threshold to determine the range of defect pixels

3) Check "Bright dark scene" or "Actual scene" to select the type of defect pixels

4) Click "Count" to complete the defect pixel analysis. The location of the defect pixels on the image will be marked and displayed in the status bar

5) Check "StaticDefectCorrection" to execute Static Defect Correction

6) When the device supports Static Defect Correction and the merged number is less than 8192, the user can through the "Save to Device" to write the statistics of the defect pixel information into the device, and it will still be valid after power off and restart

7) The user can click the "Save to File" to save the statistics of defect pixel information to a file. For details, please see section "How to Use Defect Pixel Data File"

9.3.2. Acquisition Images

1) When the device is in the stop acquisition mode, click "Catch", the image will be displayed in the GalaxyView acquisition GUI.

2) When the device is in the acquisition mode, click "Catch" to complete the image acquisition.

3) When counting defect pixels, it is required to acquisition images with uniform gray scale. For example, use bright field images when detecting dark defect pixels, and use dark field images when detecting bright defect pixels.

4) When the threshold is fixed, the number of defect pixels will be affected by the exposure time and gain. The greater the value of exposure time and gain, the greater the number of defect pixels.

5) The counted defect pixels by the device under the maximum resolution are applicable to any ROI image. The counted defect pixels by the device in the ROI are only applicable to the image in the ROI.

6) Click "  " to select the manual mark color.

7) Click "  ", set the mouse gestures as pencil to mark the defects on the image.

8) Click "  " to erase the original merged pixels on the image.

9) Click "  " to zoom in the image.

10) Click "  " to zoom out the image.

11) Click "  " to adaptive present image.

12) Click "  " to present image 100%.

13) When performing image scaling operation, the current image scaling ratio will be displayed.

14) The current image width and height, pixel coordinates of mouse position and RGB value of mouse position are displayed in the status bar.

9.3.3. Static Defect Correction

1) "StaticDefectCorrection" is divided into "StaticDefectCorrection (Software)" and "StaticDefectCorrection (Hardware)"

2) When the device perform Static Defect Correction, the plugin will give priority to hardware to implement Static Defect Correction, which will be displayed as "StaticDefectCorrection (Hardware)", otherwise it will be displayed as "StaticDefectCorrection (Software)"

3) The condition for the device to perform Static Defect Correction is that the device supports the Static Defect Correction function and the number of defects is less than 8192.

4) When the device is in the acquisition mode, the user can check or uncheck "Static Defect Correction" to check the correction result.

When the device performs Static Dead Pixel Correction, it is temporarily unable to remove the dead pixels at the left and right boundaries. The monochrome camera is 3 pixels from the boundary, and the color camera is 6 pixels from the boundary.

9.3.4. How to Use Defect Pixel Data File

1) The format of the defect pixel data file is ".dp" and ".csv", and the default save path is under the installation package directory:

   *\Daheng Imaging\GalaxySDK\Demo\Win64\resource\gxplugins\DefectPixelCorrection;

2) When you need to use the SDK to implement the Static Defect Correction function, you can read the saved defect pixel data file and call the function of the image processing library: DxStaticDefectPixelCorrection to realize the Static Defect Correction of the image.

9.4. Frame Rate Calculation Tool

Width	2448
Height	2048
BinningHorizontal	1
BinningVertical	1
DecimationHorizontal	1
DecimationVertical	1
ExposureTime(us)	10000
PixelFormat(8/10)	8
DeviceLinkThroughputLimit(Bps)	300000000
MaxUSBControllerThroughput(Bps)	380000000
AcquisitionFrameRateMode	off
AcquisitionFrameRate	79.1
FPS	59.83

MER2-502-79U3X

Figure 9-9 Frame rate calculation tool

The frame rate calculation tool is currently provided in the form of Excel. When using it, firstly select the camera model in the table, and then achieve the expected frame rate by modifying the parameter of the camera. There are four major types of influencing factors, including image readout time (image width, image height, pixel format), exposure time, acquisition frame rate control, and device link throughput limit.

Table parameter explanation:

1) The Width and Height are the set ROI size.

2) For more details about BinningHorizontal, BinningVertical, DecimationHorizontal and DecimationVertical, please refer to section 8.3.10 and section 8.3.11. These four parameters affect the transmission time of the image data.

3) The ExposureTime is the exposure time when the camera acquires one frame of image.

4) The PixelFormat is the pixel format corresponding to the camera output image, including 8 bits, 10 bits or 12 bits.

5) The DeviceLinkThroughputLimit represents the maximum bandwidth of the image transmitted by the camera.

6) The MaxUSBControllerThroughputLimit represents the recommended maximum transmission bandwidth of the camera. If this value is exceeded, frame losing may occur.

7) The AcquisitionFrameRate represents the maximum value of the frame rate control when the AcquisitionFrameRateMode is set to on, and whether the maximum value can be reached depends on whether the camera is affected by other acquisition parameters.

8) AcquisitionFrameRateMode indicates whether frame rate control is enabled, On means frame rate control is enabled, and Off means frame rate control is disabled. When frame rate control is enabled, the camera acquires images at a frame rate no higher than the AcquisitionFrameRate. When frame rate control is disabled, the camera acquires images without being affected by the AcquisitionFrameRate.

When using the frame rate calculation tool, please fill in the above information of the camera into the corresponding table. When the filled value exceeds the range or does not conform to the rules, the calculation tool will report an error. Please modify and fill in the value again according to the prompt information. When all parameters are correctly filled in, the FPS shown in the last column of the table is the theoretical frame rate currently acquired by the camera, and usually the error between this value and the actual frame rate acquired by the camera is no more than 1%.

10. FAQ

No.	General Question	Answer
1	On the unactivated Windows7 64bit system, the installation of Galaxy SDK has been successfully, but open the demo program failed.	1) Activate Windows7 64bit system, uninstall the package, restart the system, reinstall the package and reopen the demo program.
2	The cameras cannot be enumerated.	1) Please check whether the LED is green, and check whether the USB cable is connected properly, re-enumerate after re-plugging the camera. 2) Please check whether the driver of connected controller works well, reinstall the controller driver and enumerate repeatedly. 3) Please check whether the driver of host controller works well, and whether the camera displays as "USB3 Vision Digital Camera", if not, try to reinstall the setup driver.
3	Fail to open device, it shows "Load XML failed".	1) Contact with the technical support to obtain upgrade program, and then upgrade your cameras.
4	Fail to open device, it shows that "The device has been opened".	1) Please close the software which has opened the camera.
5	Fail to open device, it shows that "This device can only be operated on an USB3.0 Port".	1) Please check whether the camera is connected to USB2.0 port or USB2.0 HUB. Be sure to connect the camera to USB3.0 port.
6	No images after acquisition start.	1) Please load the default parameter set, reopen the demo, execute the command AcquisitionStart again, and then check the frame rate. 2) Open the demo, switch to stream features page, and decrease the number of StreamTransferNumberUrb to 10. Then try to execute the command AcquisitionStart again and check the frame rate. 3) Open the demo, switch to stream features page, check the statistic information, and check if any packet has been received. If there are some incomplete frames, please refer to section 2.4.
7	The frame rate is not up to the nominal value.	1) Change another PC with high performance. 2) It's recommended to use Intel host controller. 3) Be sure the main board support PCI-E2.0 or above. 4) If you have any other questions, please contact us.
8	Lose frames seriously in a multiple cameras' application.	1) The bandwidth of the camera is more than the bandwidth of the host controller. You can decrease the bandwidth through the DeviceLinkThroughputLimit function. 2) Connect the camera to the host controller separately.

No.	General Question	Answer
9	Camera crashes on Advantech AIIS-1440 IPC.	1) Be sure the driver version of AMD USB controller is later than 2.20.
10	Brightness changes (flicker) or received incomplete frames in ME2L-U3 series cameras' acquisition.	1) Be sure one USB3.0 controller can only be connected to one ME2L-U3 series camera, and no other USB devices can be connected (Including keyboard/mouse/USB flash disk, etc.).

11. Revision History

No.	Version	Changes	Date
1	V1.0.0	1. Initial release	2019-09-27
2	V1.0.1	1. Add MER2-041-436U3x, MER2-160-227U3x, MER2-230-168U3x, MER2-302-56U3x, MER2-630-60U3x, ME2P-1230-23U3x	2019-12-17
3	V1.0.2	1. Modify Figure 1-1, Figure 5-1, Figure 5-2, Figure 5-9, Figure 7-10 and Figure 8-14 2. Rename camera models, for example, rename MER2-041-436U3x to MER2-041-436U3M/C(-L) 3. Modify the power consumption of MER2-U3(-L) from <2.5W@5V to <2.7W@5V 4. Modify the weight of MER2-U3 camera from 57g to 65g 5. Modify the weight of MER2-U3-L camera from 53g to 61g	2020-03-09
4	V1.0.3	1. Add ME2P-2621-15U3M/C	2020-03-13
5	V1.0.4	1. Add ME2L-161-61U3M(-L)	2020-03-21
6	V1.0.5	1. Add section 8.4.6 Sharpness and section 8.4.8 Noise Reduction	2020-03-27
7	V1.0.6	1. Modify the I/O port of ME2L cameras from 6pin to 8pin 2. Modify the description of section 7.3 3. Modify the mechanical dimensions of ME2L cameras 4. Add the ME2L model to section 0	2020-04-30
8	V1.0.7	1. Add section 8.2.12 Set Exposure	2020-05-20
9	V1.0.8	1. Modify the description of Figure 6-1 and Figure 6-2 2. Modify the diagram and core color of Table 7-5 in section 7.3.1	2020-07-20
10	V1.0.9	1. Add section 8.4.7 and section 9.2 Flat Field Correction Plugin	2020-08-12
11	V1.0.10	1. Add the description of Global Reset Release shutter mode in section 8.2.9	2020-08-28
12	V1.0.11	1. Add ME2L-161-61U3C(-L), ME2L-203-76U3M/C, ME2L-505-36U3M/C, ME2L-830-22U3M/C 2. Add the description of auto white balance (ME2L) in section 8.4.2 3. Add the description of light source preset (ME2L) in section 8.4.1	2020-12-29
13	V1.0.12	1. Modify the exposure delay data	2021-03-10
14	V1.0.13	1. Add the description in FAQ	2021-03-16
15	V1.0.14	1. Modify the frame rate of ME2L-505-36U3M/C	2021-03-22

No.	Version	Changes	Date
16	V1.0.15	1. Add MER2-503-36U3M POL 2. Add HN-20M, HN-P-6M, HN-P-10M series of industrial lenses 3. Modify some description in section 6.2	2021-04-16
17	V1.0.16	1. Modify some description 2. Add the description in section 2.6 and section 8.3.20 3. Add MER2-630-60U3M/C-W90, MER2-1220-32U3M/C-W90, MER2-2000-19U3M/C-W90 4. Add HN-P-25M series of industrial lenses 5. Delete FCC description	2021-07-02
18	V1.0.17	1. Add ME2P-2621-15U3M/C-G2	2021-08-18
19	V1.0.18	1. Add ME2L-204-76U3C(-L)-F02	2021-09-07
20	V1.0.19	1. Add MER2-135-208U3M/C(-L)	2021-09-22
21	V1.0.20	1. Add Raw12 and remove parameter limits feature for MER2-231-41U3M/C camera	2021-12-22
22	V1.0.21	1. Add section 8.2.12.3 Exposure Time Mode 2. Add the description in section 8.3.11 3. Add the camera modes in section 8.3.17 4. Add HN-6M series of industrial lenses	2022-01-10
23	V1.0.22	1. Modify section 7.3.1.2 to add the series resistance requirement when the external voltage of Line0+ is 5V and modify Table 7-7 2. Modify section 7.3.2.1 to add the series resistance requirement when the external voltage of Line0+ is 5V and modify Table 7-7	2022-02-16
24	V1.0.23	1. Add section 9.1.2.5 Read LUT	2022-03-22
25	V1.0.24	1. Add section 8.4.1 Light Source Preset 2. Add section 8.4.9 Saturation 3. Update the information of ME2P-2621-15U3M/C 4. Add ME2P-2622-15U3M/C, ME2P-2622-15U3M NIR, ME2P-2621-15U3M NIR	2022-04-21
26	V1.0.25	1. Update the information of ME2P-1230-23U3M/C 2. Add ME2P1231-32U3M/C 3. Modify Figure 4-49, Figure 4-53	2022-05-20
27	V1.0.26	1. Update the information of MER2-502-79U3M/C, MER2-503-36U3M/C, MER2-630-60U3M/C 2. Add MER2-502-79U3M POL	2022-06-20
28	V1.0.27	1. Update the information of MER2-1220-32U3M/C, MER2-2000-19U3M/C	2022-07-04

No.	Version	Changes	Date
29	V1.0.28	1. Add MER2-135-150U3M/C(-L), ME2P-560-36U3M/C, ME2P-900-43U3M/C, ME2P-1840-21U3M/C 2. Update the information of MER2-160-227U3M/C(-L), MER2-230-168U3M/C(-L) 3. Update the spectral response of ME2P-2621-15U3M/C, ME2P-2622-15U3M/C, ME2P-2621-15U3M NIR, ME2P-2622-15U3M NIR 4. Add the description of FCC in section 2.6 5. Update the description of operation system in section 4 6. Update the mechanical dimensions in section 5.1 7. Update Figure 6-1 and Figure 6-2 8. Update the information of HN-P-6M series lenses in section 6.2.5 9. Update the information of ME2L series I/O port in section 7.3	2022-11-11
30	V1.0.29	1. Add MER2-041-528U3M/C(-L) 2. Update the information of MER2-301-125U3M/C(-L), MER2-302-56U3M/C(-L) 3. Update the diagram and description of Strobe ExposureActive, TrigggerWait and other signals in section 8.1.2 4. Add section 8.3.2 Sensor Bit Depth	2023-01-06
31	V1.0.30	1. Update the information of: MER2-160-227U3M/C(-L)/MER2-230-168U3M/C(-L) MER2-231-41U3M/C(-L)/MER2-502-79U3M/C(-L) MER2-502-79U3M POL/MER2-503-36U3M/C(-L) MER2-503-36U3M POL/ME2P-1230-23U3M/C ME2P-1231-32U3M/C	2023-02-02
32	V1.0.31	1. Update Figure 5-9 and Figure 5-10	2023-02-22
33	V2.0.0	1. Add ME2S-1260-28U3M/C, ME2S-1610-24U3M/C, ME2S-2020-19U3M/C, ME2S-2440-16U3M/C 2. Add section 2.1 Safety Claim, section 2.2 Safety Instruction, section 8.2.6 Acquisition Burst Mode and section 8.4.7.4 FFC Precautions 3. Update the parameter figure in section 4 4. Add ME2S mechanical dimensions in section 5.1 5. Update Figure 6-1 and Figure 6-2 6. Add HN-P-6M (1/1.8") series prime lenses, HN-P-20M series prime lenses, HN-P series line scan lenses 7. Update section 7.3 8 I/O Port, section 8.1 I/O Control, section 8.2.12 Set Exposure, section 8.2.13 Exposure delay, section 8.4.1 Light Source Preset, section 8.4.2 Auto White Balance and section 8.4.3 Color Transformation Control	2023-07-11
34	V2.0.1	1. Add ME2S-560-70U3M/C 2. Add section 8.3.15.2 Auto Black Level	2023-08-03

No.	Version	Changes	Date
35	V2.0.2	1. Add the information of: ME2L-042-120U3M/C(-L) / ME2L-204-76U3M(-L)-F02 MER2-041-608U3M/C(-L)-HS / MER2-502-79U3M/C(-L)-HS MER2-502-79U3M-HS POL 2. Add section 8.7 Sequencer 3. Update the UI interface and usage description related to the software	2023-09-09
36	V2.0.3	1. Update the power consumption of ME2S-1610-24U3M/C, ME2S-2020-19U3M/C, ME2S-2440-16U3M/C	2023-09-21
37	V2.0.4	1. Add MER2-160-249U3M/C(-L)-HS, MER2-240-160U3M/C(-L) 2. Update some model parameters in Table 8-2 Camera exposure delay range	2023-10-09
38	V2.0.5	1. Add MER2-301-125U3M/C-HS, ME2P-1230-30U3M/C-HS 2. Update some model parameters in Table 8-2 Camera exposure delay range 3. Update sensor binning information of MER2-301-125U3M/C(-L), ME2P-1230-23U3M/C, ME2P-1231-32U3M/C 4. Update the description of conformity in section 4	2023-12-19
39	V2.0.6	1. Add MER2-630-60U3M/C-W90-S90, MER2-1220-32U3M/C-W90-S90, MER2-2000-19U3M/C-W90-S90 2. Add Figure 5-4 and update Figure 5-1, Figure 5-3, Figure 5-10, Figure 5-11 3. Update the description of dimensions in section 4.7	2024-01-02
40	V2.0.7	1. Add MER2-501-79U3M/C(-L), ME2P-530-72U3M NIR, ME2P-530-72U3C	2024-03-28
41	V2.0.8	1. Add MER2-303-107U3M/C(-L), MER2-304-56U3M/C(-L), MER2-510-36U3M/C(-L) 2. Update Figure 7-9 and Figure 7-11	2024-04-18
42	V2.0.9	1. Add MER2-280-139U3M/C(-L) 2. Update some parameters of MER2-303-107U3M/C(-L), MER2-304-56U3M/C(-L)	2024-05-23
43	V2.0.10	1. Add ME2P-170-210U3M/C 2. Add section 8.2.9 Counter Trigger Acquisition and Configuration and section 8.7 UART Port	2024-06-06
44	V2.0.11	1. Add ME2P-883-42U3M/C 2. Add section 8.4.10 MultiColor Adjustment 3. Update some parameters of MER2-2000-19U3M/C(-L)	2024-11-20
45	V2.0.12	1. Add MER2-041-608U3M/C(-L)-HS-6P, MER2-160-249U3M/C(-L)-HS-6P 2. Add section 8.2.10 TriggerCache 3. Update the typical power of MER2-U3(-L), ME2S-U3 and ME2P-U3 series	2025-02-14

No.	Version	Changes	Date
46	V2.0.13	1. Add MER2-2002-20U3M/C(-L) 2. Update section 8.1.2, add the Strobe signal schematic (rolling shutter) 3. Update section 8.3.18, Add the description of rolling shutter camera	2025-03-28
47	V2.0.14	1. Add MER2-060-642U3M(-L) 2. Add section 8.5.1 Frame Buffer Control	2025-05-22
48	V2.0.15	1. Add ME2S-2560-15U3M, ME2P-1231-32U3M POL	2025-06-18
49	V2.0.16	1. Add ME2S-138-136U3M-SWIR, ME2S-138-232U3M-SWIR 2. Add section 8.4.11 Fixed Pattern Noise Correction, section 8.4.12 Defect Pixel Correction	2025-07-21

12. Contact Us

12.1. Contact Sales

If you need to order products or inquire product information, please contact our sales:

Tel: +86 10 8282 8878-8081

Email: isales@deheng-imaging.com

12.2. Contact Support

If you have any questions in using DAHENG IMAGING products, please contact the experts on our support team:

Tel: +86 10 8282 8878

Email: isupport@daheng-imaging.com