MARS GigE Cameras

User Manual

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Notice

Preface

We really appreciate you choosing the product of DAHENG IMAGING.

MARS GigE series camera is DAHENG IMAGING's mature area scan digital camera, featuring mega pixels resolution, high definition, extremely low noise and perfect color conversion. The camera, which is equipped with a standard GigE interface, supports Power over Ethernet (PoE, compatible of IEEE802.3af standard) and is convenient for use and connection. It could be used in a wide and diverse range of applications including machine vision, high-definition imaging and surveillance, medical imaging, intelligent transportation systems, character recognition and documents processing, and any more.

The MARS GigE series camera is a compact camera that will be a good choice for the users who are demanding on the camera size. This manual describes in detail on how to install and use the MARS GigE digital cameras.

Contents

1. Introduction

1.1. Models

The current MARS GigE Vision camera models are listed in the top row of the specification tables on the next pages of this manual. The camera models are differentiated by their resolution, their maximum frame rate at full resolution, and whether the camera's sensor is mono or color.

1.2. MARS-Gx-P series General Specifications

1.2.1. MARS-880-13Gx-P

Specifications	MARS-880-13GC-P	MARS-880-13GM-P
Resolution	4096×2160	
Sensor Type	Sony IMX267, global shutter CMOS	
Optical Size	1 inch	
Pixel Size	3.45μm×3.45μm	
Frame Rate	12.1fps@4096×2160 (Default) 13fps@4096×2160 (adjust the packet to 8192 and bandwidth-reserved is 7)	
ADC Bit Depth	12bit	
Pixel Bit Depth	8bit, 12bit	
Shutter Time	36μs~1s	
Gain	0dB~24dB	
Pixel Data Formats	Bayer RG8/Bayer RG12	Mono8/Mono12
Signal Noise Ratio	39.9dB	39.9dB
Definition	>1758Line	>1979Line
Synchronization	external trigger, software trigger	
I/O	1 opto-isolated input line and 1 opto-isolated output line, 2 GPIOs	
Operating Temp.	0°C~45°C	
Storage Temp.	-20°C~70°C	
Operating Humidity	10%~80%	
Camera Power Requirements	PoE (Power over Ethernet 802.3af compliant) or +12 VDC (± 10%), supplied via the camera's 8-pin Hirose connector	
Power Consumption	< 3W@12VDC, <3.5W@PoE	
Lens Mount	C	
Dimensions	50.4mm×62mm×62 mm (without lens adapter or connectors)	
Weight	274g	

Software	Windows XP/Win7/Win8 32bit, 64bit OS
Data Interface	Fast Ethernet(100Mbit/s) or Gigabit Ethernet(1000Mbit/s)
Programmable Control	Image size, gain, Exposure time, trigger polarity, flash polarity
Conformity	CE, RoHS, GigE Vision, GenICam, IEEE802.3af

Table 1- 1:   MARS-880-13Gx-P General Specifications

1.2.2. MARS-1230-9Gx-P

Specifications	MARS-1230-9GC-P	MARS-1230-9GM-P
Resolution	4096×3000	
Sensor Type	Sony IMX304, global shutter CMOS	
Optical Size	1.1 inch	
Pixel Size	3.45μm×3.45μm	
Frame Rate	8.7fps@4096×3000 (Default) 9fps@4096×3000 (adjust the packet to 8192 and bandwidth-reserved is 5)	
ADC Bit Depth	12bit	
Pixel Bit Depth	8bit, 12bit	
Shutter Time	36μs~1s	
Gain	0dB~23.9dB	
Pixel Data Formats	Bayer RG8/Bayer RG12	Mono8/Mono12
Signal Noise Ratio	40dB	40dB
Definition	>2337Line	>2611Line
Synchronization	external trigger, software trigger	
I/O	1 opto-isolated input line and 1 opto-isolated output line, 2 GPIOs	
Operating Temp.	0°C~45°C	
Storage Temp.	-20°C~70°C	
Operating Humidity	10%~80%	
Camera Power Requirements	PoE (Power over Ethernet 802.3af compliant) or +12 VDC (± 10%), supplied via the camera's 8-pin Hirose connector	
Power Consumption	< 3W@12VDC, <3.5W@PoE	
Lens Mount	C	
Dimensions	50.4mm×62mm×62 mm (without lens adapter or connectors)	
Weight	274g	
Software	Windows XP/Win7/Win8 32bit, 64bit OS	
Data Interface	Fast Ethernet(100Mbit/s) or Gigabit Ethernet(1000Mbit/s)	

Programmable Control	Image size, gain, Exposure time, trigger polarity, flash polarity
Conformity	CE, RoHS, GigE Vision, GenICam, IEEE802.3af

Table 1- 2: MARS-1230-9Gx-P General Specifications

1.3. Spectral Response

1.3.1. MARS-880-13Gx-P
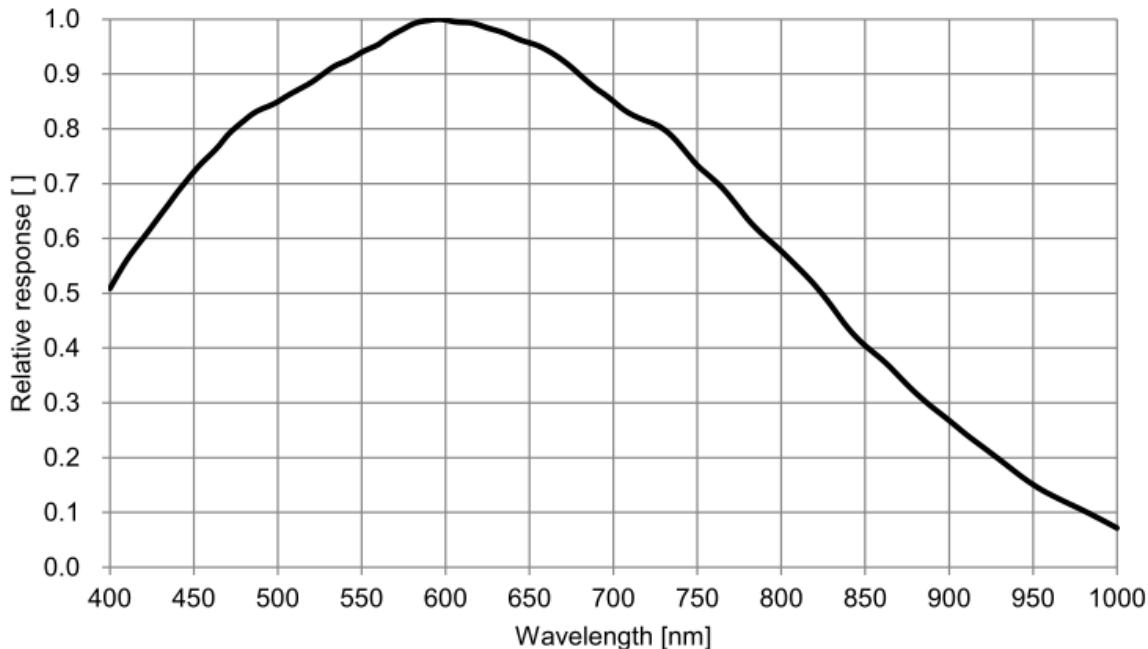
Figure1- 1: MARS-880-13GM-P Sensor Spectral Response
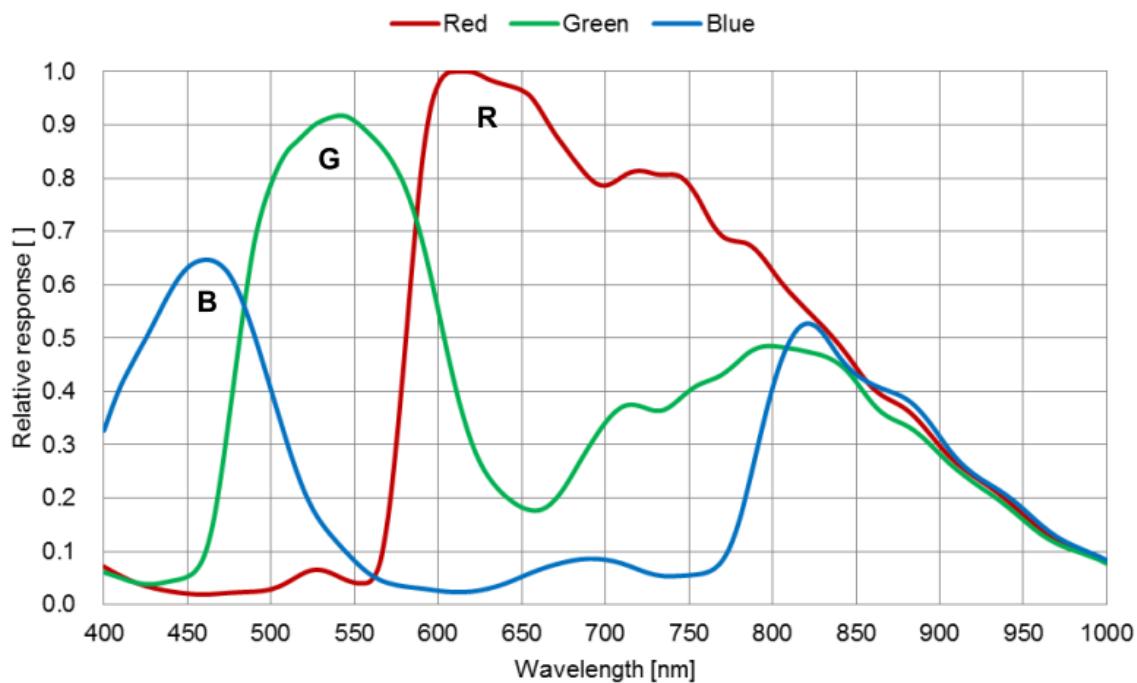
Figure1- 2: MARS-880-13GC-P Sensor Spectral Response

1.3.2. MARS-1230-9Gx-P
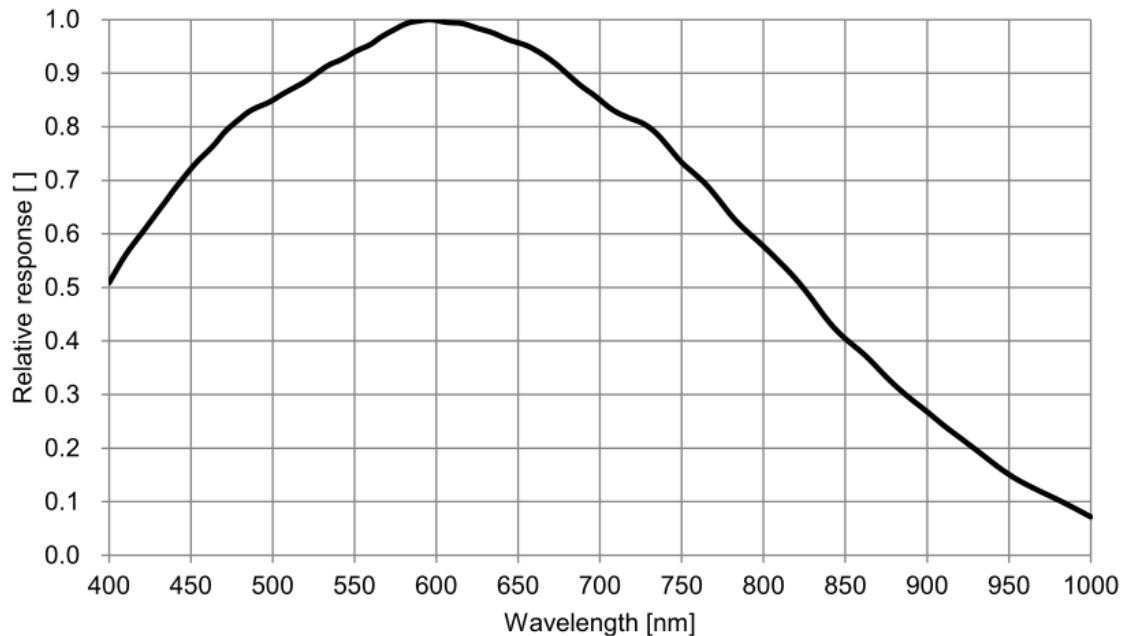
Figure1- 3: MARS-1230-13GM-P Sensor Spectral Response
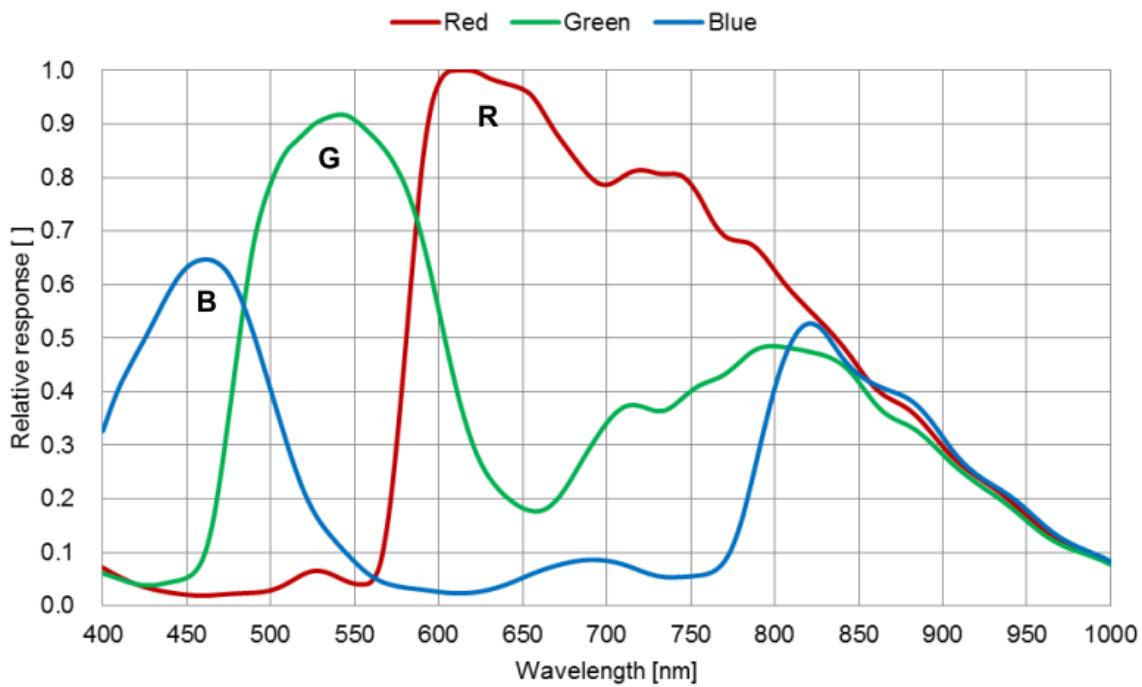
Figure1- 4: MARS-1230-13GC-P Sensor Spectral Response

1.3.3. Filters

Each MARS color camera is equipped with an additional infrared cut-off filter, and each monochrome camera is equipped with a piece of anti-reflection glass. The following are their specifications and spectral response.
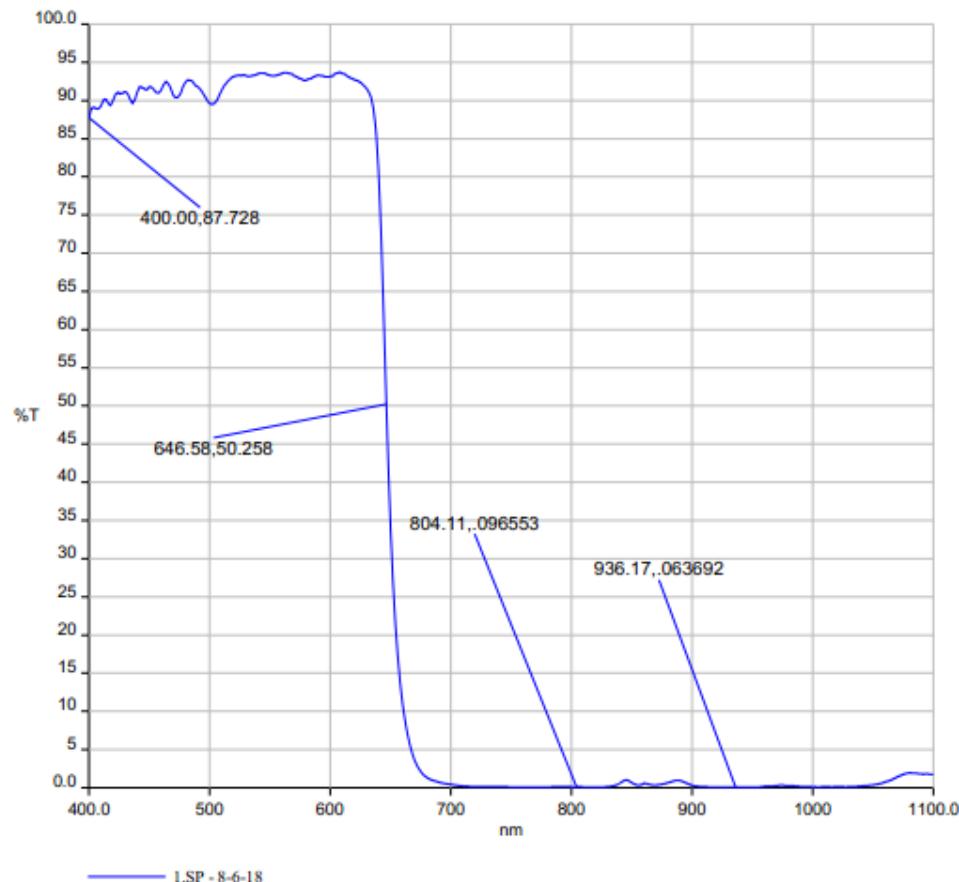
Figure1- 5: Infrared Cut-Off Filter Spectral Response for MARS Series Color Camera
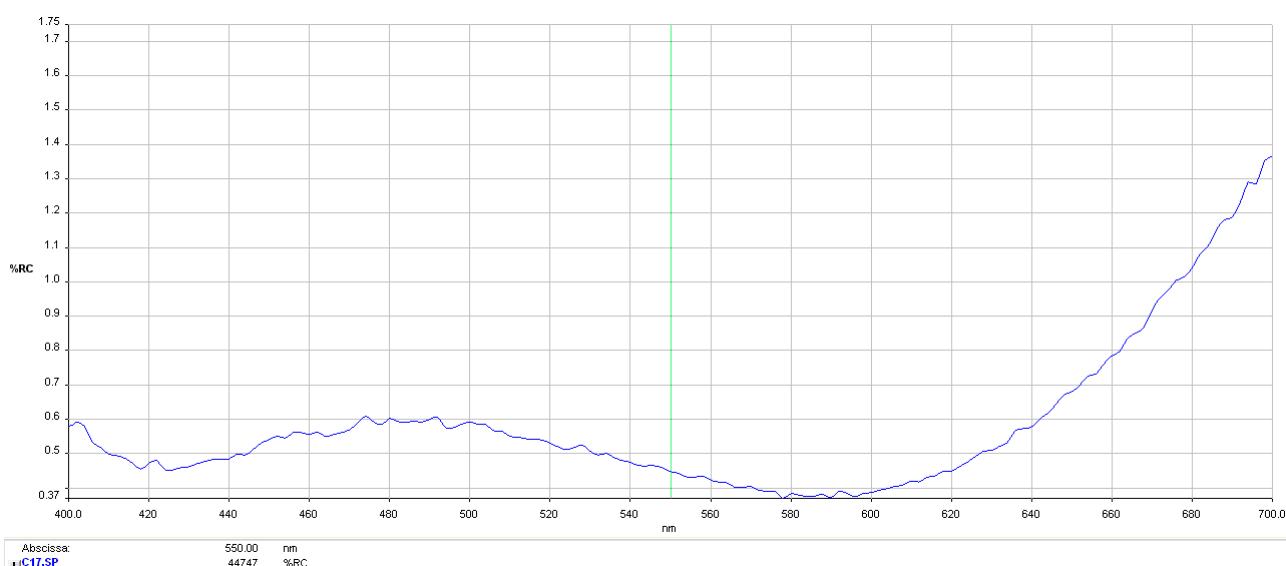
Figure1- 6: Transparent Glass Spectral Response for MARS Series Mono Camera

1.4. MARS-Gx-P series Mechanical Interface

1.4.1. Mechanical dimensions
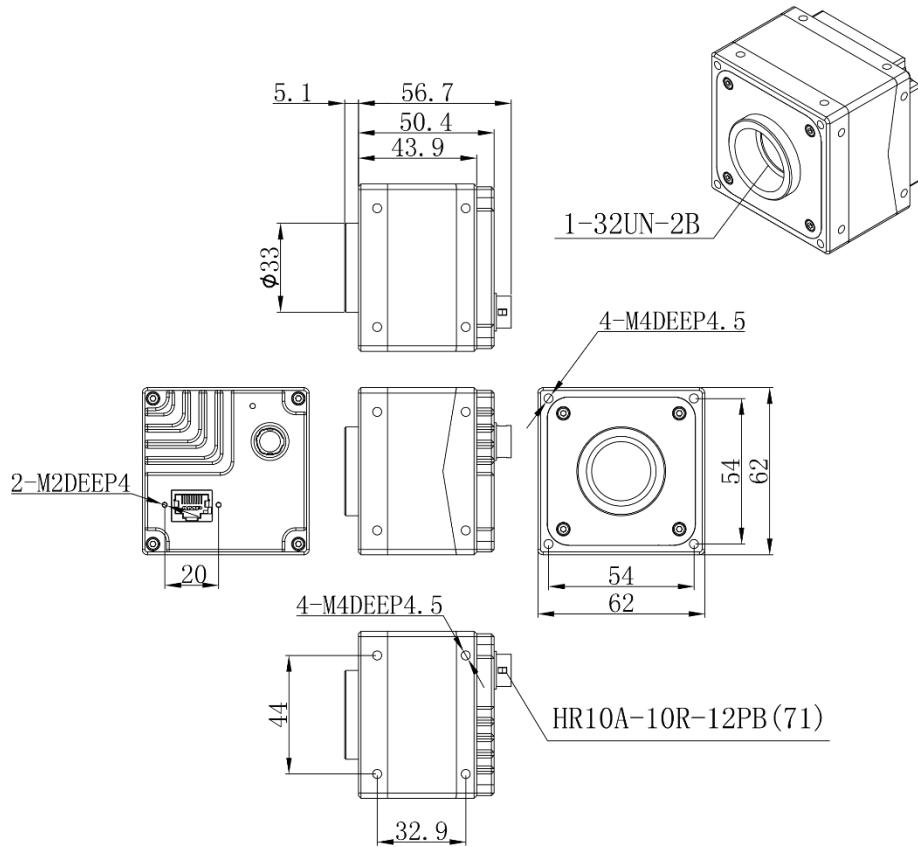
Figure1- 7: Mechanical dimensions

1.4.2. Optical interface
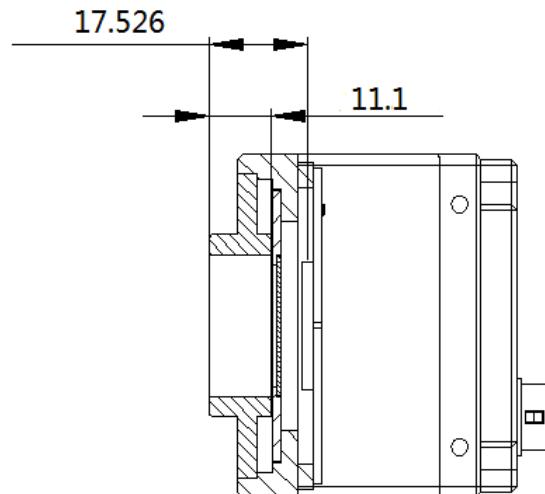
Figure1- 8: Optical interface

MARS cameras are equipped with C-mount lens adapters. The back-flange distance is 17.526 mm (in the air). The maximum allowed thread length of lens is 11.3mm, as shown in Figure1- 8. A longer lens thread will damage camera.

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 need to be removed.

1.5. Software Interface

1.5.1. Software Package

The Software package of DAHENG IMAGING's MARS series that is used to control the MARS series camera, is to provide a stable, real-time image transmission, and provide a free SDK and abundant development example source code. The package is composed of the following modules:

1) Driver Package (Driver): This package provides the MARS series camera driver program, such as: the GigE Vision cameras' Filter 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 also the user can develop their own control program based on the camera interface library.

4) IP configuration tool (GxGigeIPConfig.exe): The tool is used to configure the camera IP address and to set the IP mode when the camera is powered on.

5) Sample: These samples demonstrate cameras' functions, the user can easily use these samples to control cameras, and also can refer to the samples to develop their own control program.

6) 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 acquisition images through the camera interface library.

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

1.5.2. User software interface

After installing the MARS series 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 also provides the samples and software development manual which are based on these interfaces.

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, 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)   GigE Vision interface

The MARS series GigE Vision camera is compatible with the GigE Vision protocol, which allows the user to control the camera directly through the GigE Vision protocol. In addition, the user can use some third-party software that supports the GigE 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.
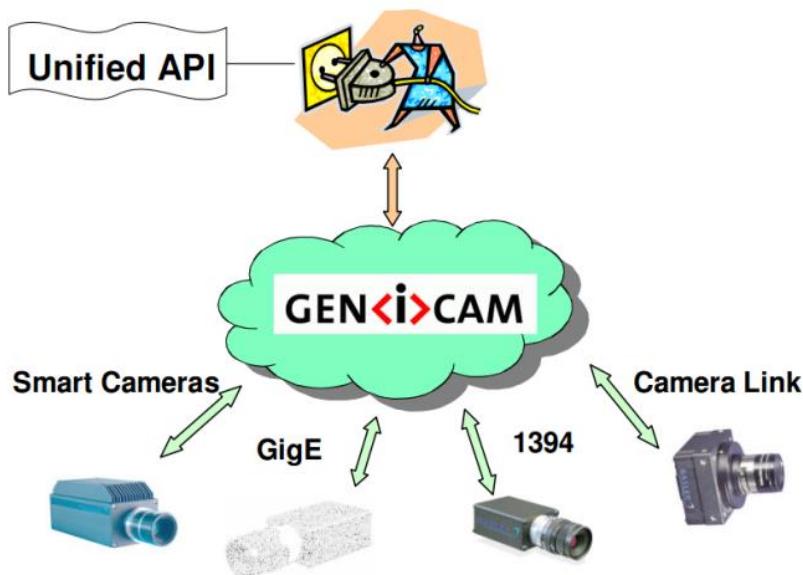
Figure1- 9:   GEN<i>CAM standard schematic diagram

1.6. Guideline for Avoiding EMI

1)   CAT-5e cables or above with S/STP shielding 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) Try to use camera cables that are the correct length. Avoid coiling camera cables. If the cables are too long, use a meandering path rather than coiling the cables.

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

5) 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.

1.7. Environmental Requirements

1) Housing temperature during operation：0°C ~ 45°C, Humidity during operation:10% ~ 80% (relative, non-condensing); 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, 2.4GHzor above, and more than 2GB memory.

4) NIC requirement: Intel Pro 1000 NIC or above Gigabit LAN, confirm to IEE802.3af; Gigabit Switch, CAT-5e cables or above, less than 100m, confirm to IEE802.3af.

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

1.8. Standards and Regulations

DAHENG IMAGING's cameras are compliant with CE, RoHS regulations.

2. Features

2.1. I/O Control

2.1.1. Input Mode Operation

1) Configuring Line as input

The MARS-Gx-P series camera has three input signals: Line0, Line2, and Line3. In which the Line0 is uni-directional opto-isolated input, Line2 and Line3 are bi-directional line 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 external trigger, the MARS-Gx-P series camera has the external trigger filtering function, including rising edge filtering and falling edge filtering. The user can set the trigger filter function by setting the "TriggerFilterRaisingEdge" and the "TriggerFilterFallingEdge". The range of the trigger filter function is [0, 5000] μs, step: 1μs.

Example 1: Setting the rising edge filter width is 1ms, the pulse width less than 1ms in the rising edge will be filtered out, as shown in Figure2- 1:
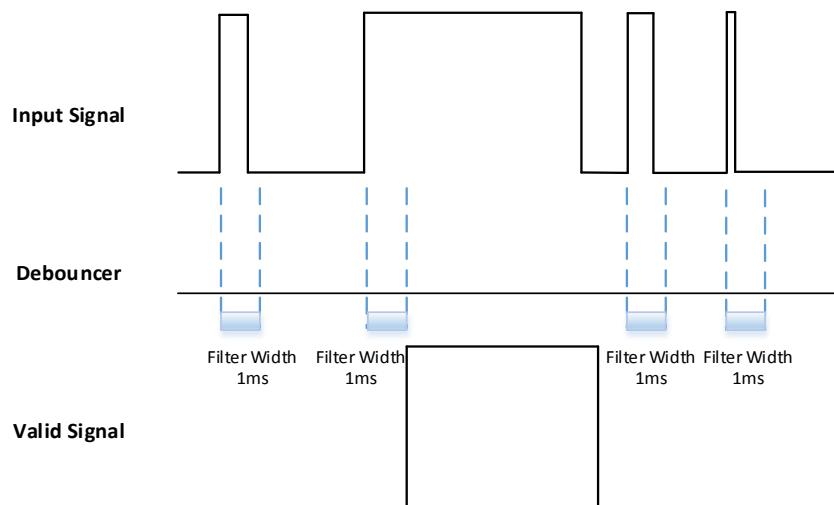
Figure2- 1: input signal filter schematic diagram

3) Trigger Delay

The MARS-Gx-P series camera has trigger delay function. The user can set the trigger delay function by setting "TriggerDelay". The range of the trigger delay function is [0, 3000000] μs, step: 1μs.

Example 1: Setting the trigger delay value to be 1000ms, and the trigger signal will be valid after 1000ms delay, as shown in Figure2- 2.
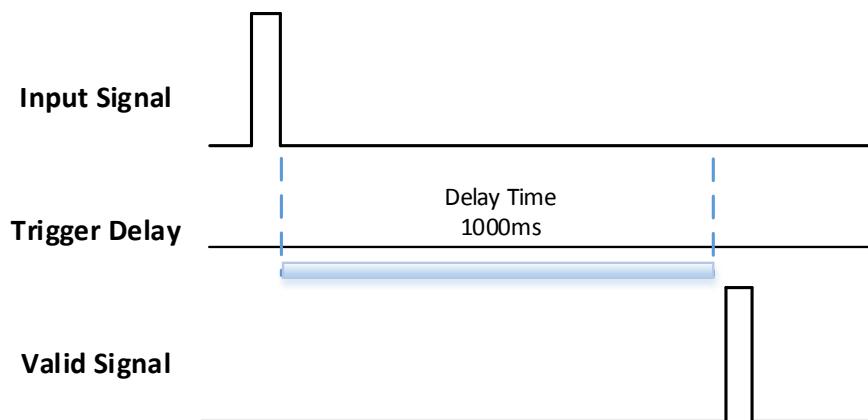
Figure2- 2: trigger delay schematic diagram

4)   Input Inverter

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

For the MARS-Gx-P series camera, 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 Figure2- 3:
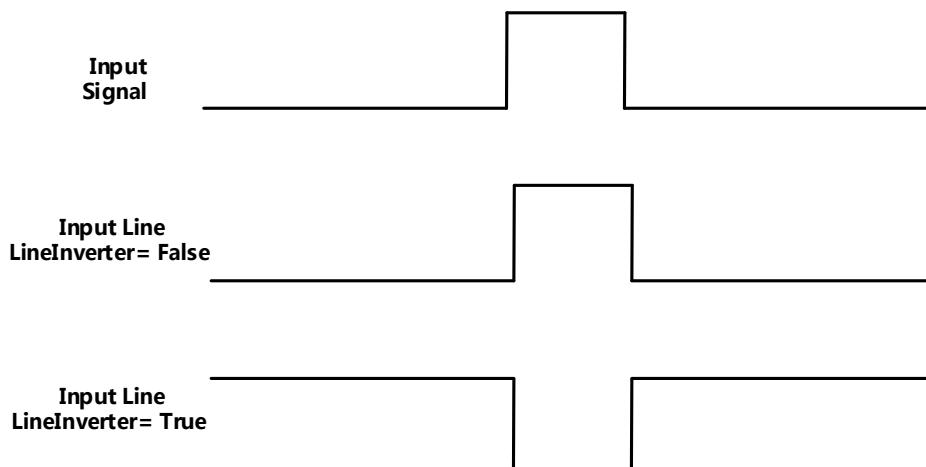
Figure2- 3: setting input line reverse

2.1.2. Output Mode Operation

1)   Configuring lines

The MARS-Gx-P series camera has three output signals: Line1, Line2, and Line3. In which the Line1 is a uni-directional opto-isolated output I/O, Line2 and Line3 are bi-direction configurable I/Os.

The camera's default output is Line1 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 can be configurable, and the output source includes: Strobe, UserOutput0, UserOutput1, and UserOutput2.

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

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

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

By setting "UserOutputSelector" to select the output UserOutput0, UserOutput1, 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 MARS-Gx-P series camera has the function of configurable 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 Figure2- 4.
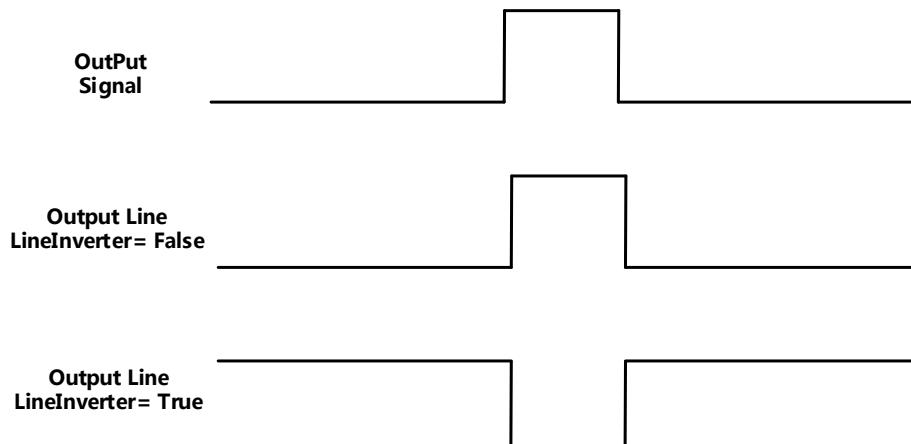
Figure2- 4: set output line reversion

2.1.3. Read the LineStatus

1) Read the level of single line

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

2) Read all the lines level;

The MARS-Gx-P series camera can get the current status of all lines. On the one hand, the signal status is the status of the external IO after the reversal of the polarity. On the other hand, signal status level can reflect the external IO level.

All the lines level status bit of the MARS-Gx-P series camera are shown in Table2- 1. The default polarity does not reverse, and the default value is oxC.

Line3	Line2	Line1	Line0
1	1	0	0

Table2- 1: camera line status bit

2.2. Image Acquisition Control

2.2.1. Acquisition Start and Stop

2.2.1.1. Acquisition Start

It is allowed to send **Acquisition Start** command immediately after opening the camera. The acquisition process in continuous mode is illustrated in Figure2- 5, and the acquisition process in trigger mode is illustrated in Figure2- 6.

● **Continuous Acquisition：**
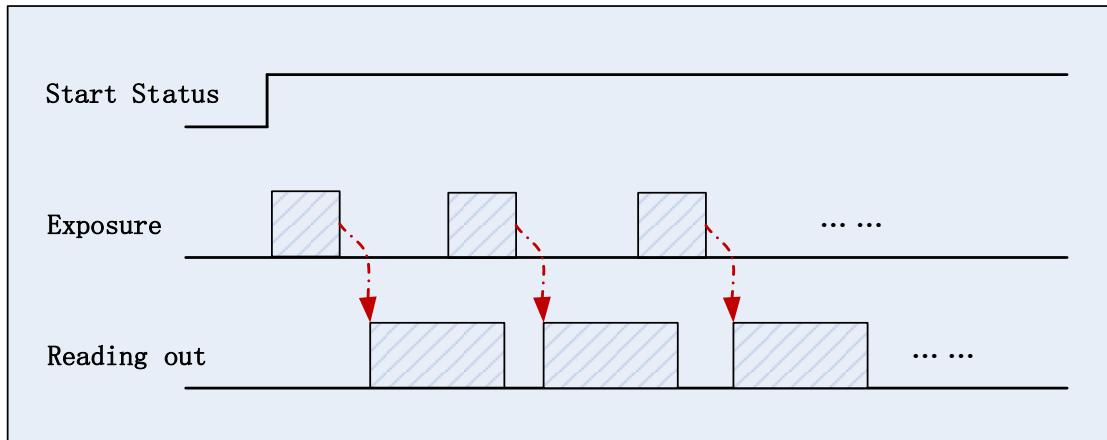
Figure2- 5: Continuous acquisition process

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：**
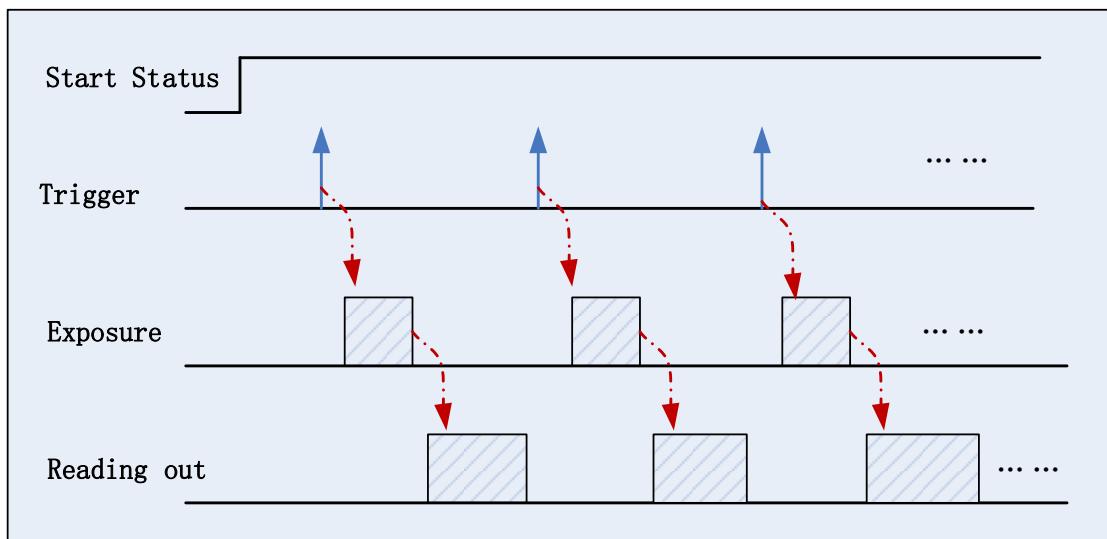
Figure2- 6: Triggered acquisition process

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 external trigger), the camera will acquire and transmit a frame. The maximum frame rate in trigger mode is depended on the exposure time, ROI and some other parameters.

2.2.1.2. Acquisition Stop

It is allowed to 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 Figure2- 7 and Figure2- 8.

● **Acquisition stop during reading out：**
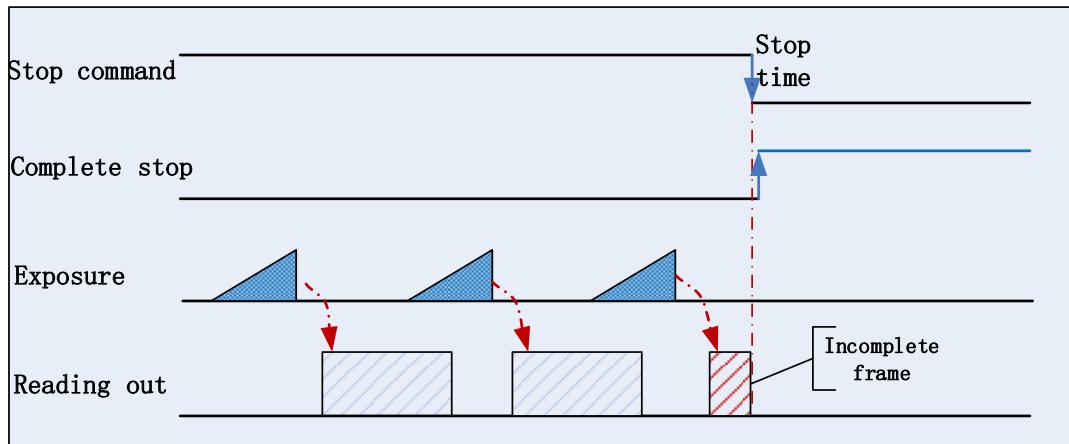
Figure2- 7: Acquisition stop during reading out

As shown in Figure2- 7, when the camera receives an acquisition stop 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：**
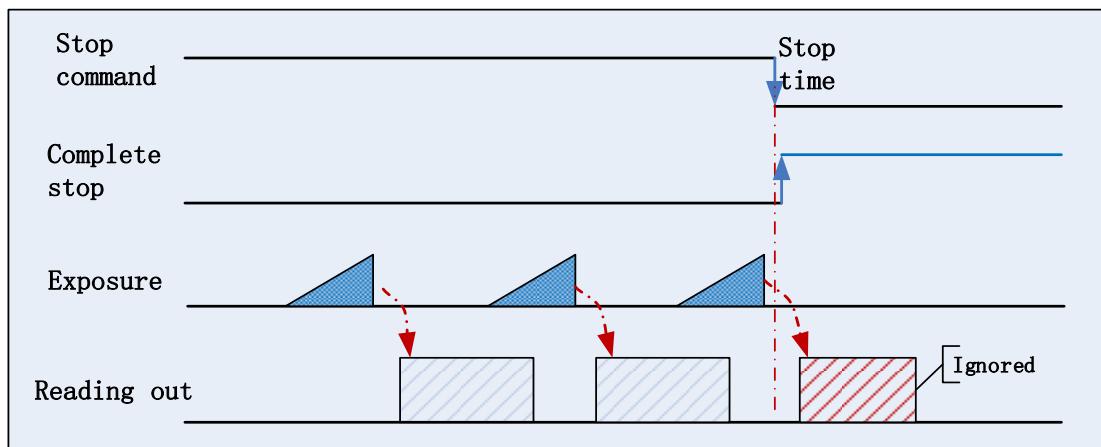
Figure2- 8: Acquisition stop during blanking

After the camera transferred a whole frame, the camera goes into wait state. When user sends an Acquisition Stop command in wait state, the camera will return to stop-finished state. The camera won't send any frames even if it is just going to start the next exposing.

2.2.2. Switching Acquisition Mode

Trigger mode supports two options: **ON** and **OFF**. When trigger mode is set **OFF**, the camera works in continuous mode; when trigger mode is set **ON**, the camera works in trigger mode. It can be switched between **ON** and **OFF** any time after the camera is opened.

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

- **Switch acquisition mode during frame reading out**
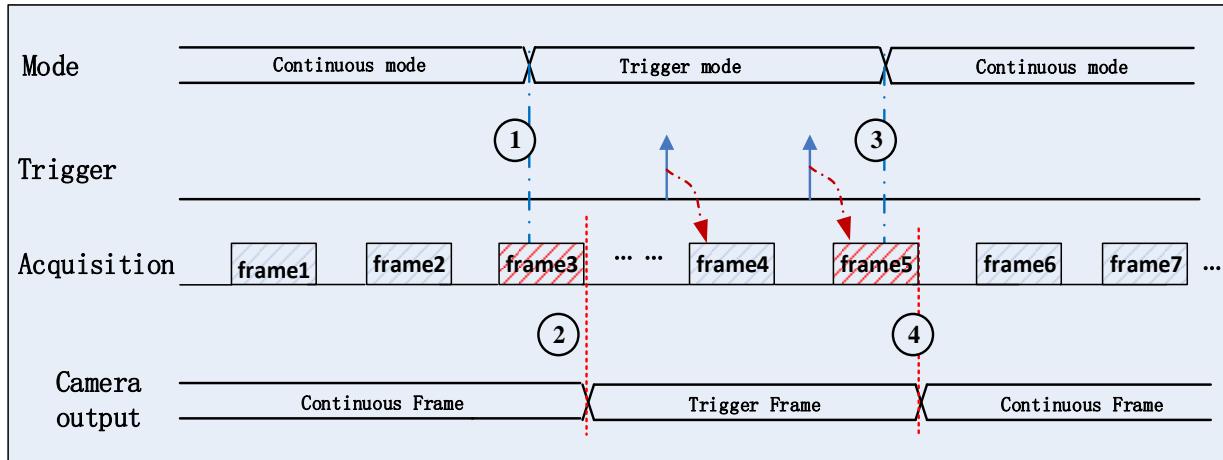
Figure2- 9: Switch acquisition mode during reading out

As shown in Figure2- 9, 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 actually switches from trigger mode to continuous mode at point 4, and then the camera works in continuous mode.

- **Switch acquisition mode during blanking(or exposure)**
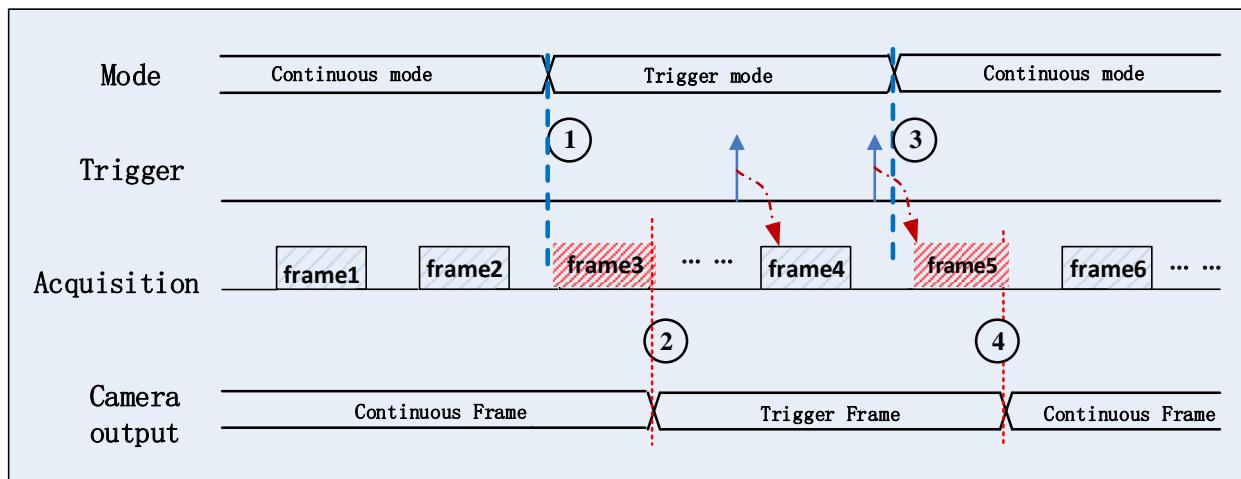
Figure2- 10: Switch acquisition mode in waiting time

As shown in Figure2- 10, 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 3th frame is finished (including exposure and reading out), i.e., point 2.Please note that the 3rd frame does not belong to trigger mode. All trigger frames need trigger signals or

soft-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 actually, and then the camera works in continuous mode.

2.2.3. 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 OFF** to use continuous mode.

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

● **Continuous mode features**

In continuous acquisition mode, the camera captures and transfers images according to camera parameter settings.

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

2.2.4. Software Trigger Acquisition and Configuration

● **Software trigger acquisition configuration**

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

Set the **Trigger Mode** to **ON**.

Set the **Trigger Source** to **Software**.

Send **Software Trigger** command.

All of the software trigger commands are sent by the host through the USB bus, to trigger the camera to capture and transmission 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 function can control the camera delay interval between your triggers and the camera acquiring frames. The default value of trigger delay time is zero.

2.2.5. External Trigger Acquisition and Configuration

- **External trigger acquisition configuration**

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

Set the **Trigger Mode** to **ON**.

Set the **Trigger Source** to **Line0**.

Connect external 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 2.1.1 for more information of the programmable GPIO interfaces.

- **Trigger acquisition features**

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

1) The polarity of lines can be set by **inverted** or **not inverted**; 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 us. The default configuration is not use trigger filter.

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

The functions, like trigger polarity, trigger delay and trigger filter, can be select in the Galaxy View.

⚠ The camera's trigger source Line0 use opto-isolated circuit to isolate signal. Its internal circuit delay trigger signal and rising edge's delay time is longer 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 20-40μs) and the negative pulse signal's negative width will be narrower (about 20-40μs). You can adjust filter parameter to accurately filter trigger signal.

2.2.6. Set Exposure

- **Global Shutter**

The implementation process of global shutter sensor is as shown in Figure2- 11, 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 sensor is that all the lines are exposed at the same time, and the images do not appear offset and distortion when capturing moving objects.

All lines are exposing at the same time

All lines transfer electrons from exposure area to storage area

Reading electrons from storage area line by line

Exposure time

Readout time

Time
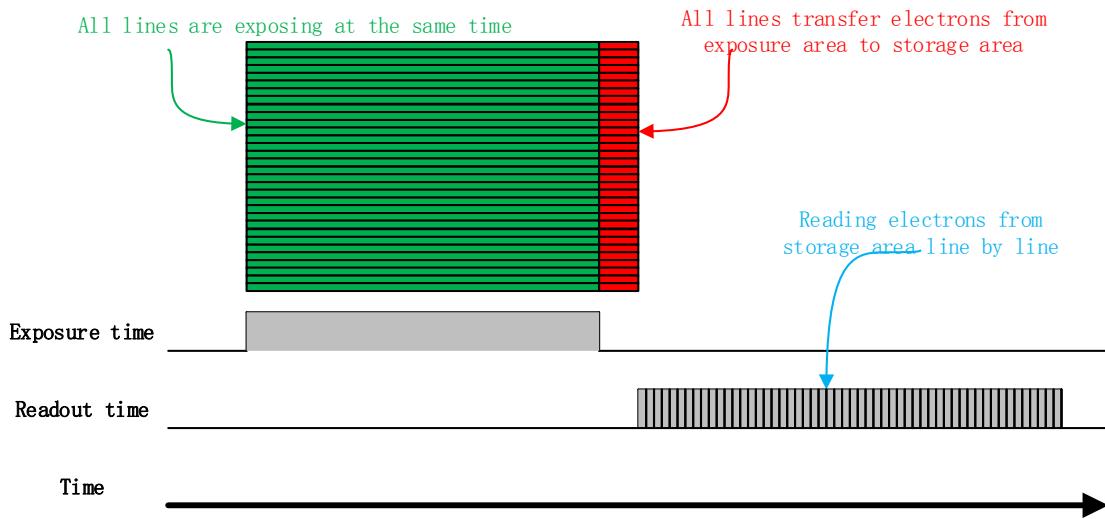
Figure2- 11: Global Shutter

- **Electronic Rolling Shutter**

Exposure line by line

Readout after exposure

Exposing

Exposure time

Reading

Readout time

Time
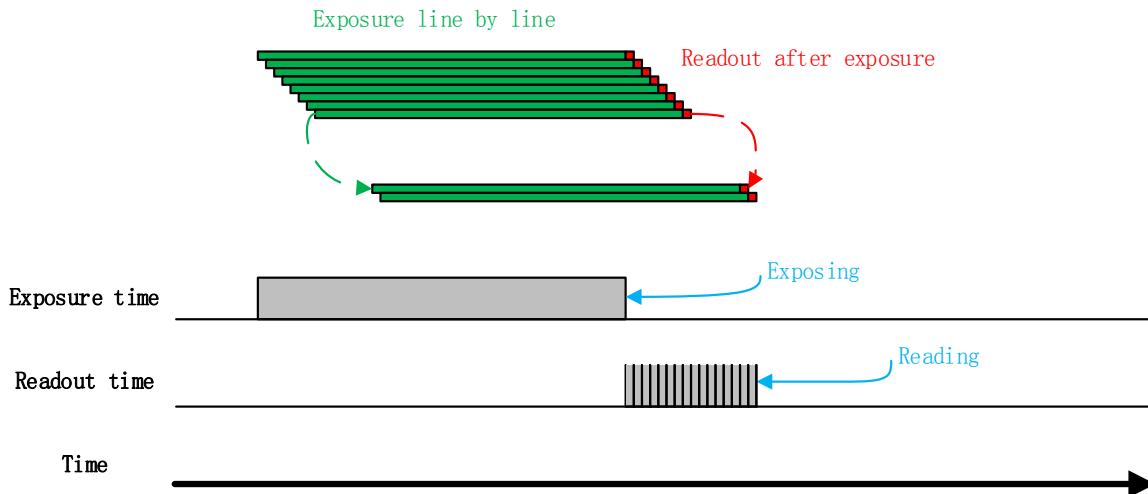
Figure2- 12: Electronic rolling shutter

The implementation process of electronic rolling shutter sensor is as shown in Figure2- 12, 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 sensor is low price and high resolution, which is a good choice for some static image acquisition.

- **Setting the exposure time**

The MARS-Gx-P series camera supports setting the exposure time, step: 1μs. The exposure time is shown as follows:

Model	Exposure Mode	Adjustment Range (μs)	Steps (μs)	Actual Steps

| MARS-880-13Gx-P | Global Shutter | 36-1000000 | 1 | 1 |
| MER-1230-9Gx-P | Global Shutter | 36-1000000 | 1 | 1 |

Table2- 2: MARS-Gx-P series camera exposure time setting range

* 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 is 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 21.5us, setting 80us exposure time, and the actual exposure time is 86us.

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 MARS-Gx-P series camera supports automatic exposure function. If the automatic exposure function is enabled, the camera can adjust the exposure time automatically according to the environment brightness. See 2.3.4 section for more details.

2.2.7. Overlap exposure and non-overlap exposure

There are two stages in image acquisition of the MARS-Gx-P series 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 MARS-Gx-P series camera supports two exposure modes: overlap exposure and non-overlap exposure. The user cannot assign the overlap exposure or non-overlap exposure directly, it depends on the frequency of trigger signal and the exposure time。The two exposure mode are described as below:

● **Non-overlap exposure**

In non-overlap 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 Figure2- 13, the N frame is read out, after a period of time, the N+1 frame to be exposed.

The formula of non-overlap exposure frame period:

non-overlap exposure frame period > exposure time + readout time
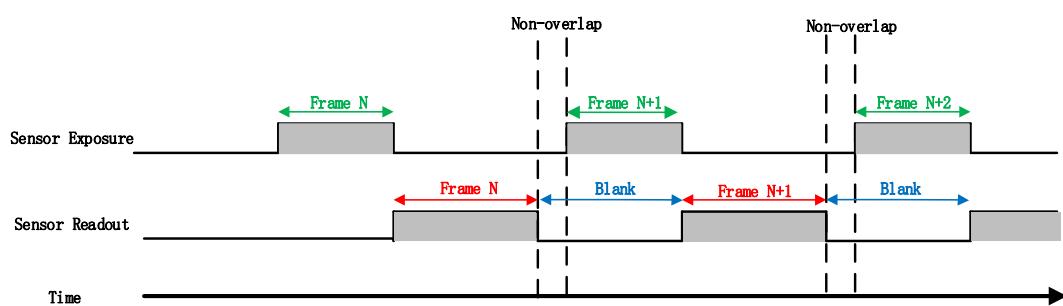
Figure2- 13: the exposure sequence diagram in non-overlap exposure mode

● **Trigger acquisition mode in non-overlap exposure mode**

If the interval between two triggers is greater than the sum of the exposure time and readout time, it will not occur overlap exposure, as shown in Figure2- 14.
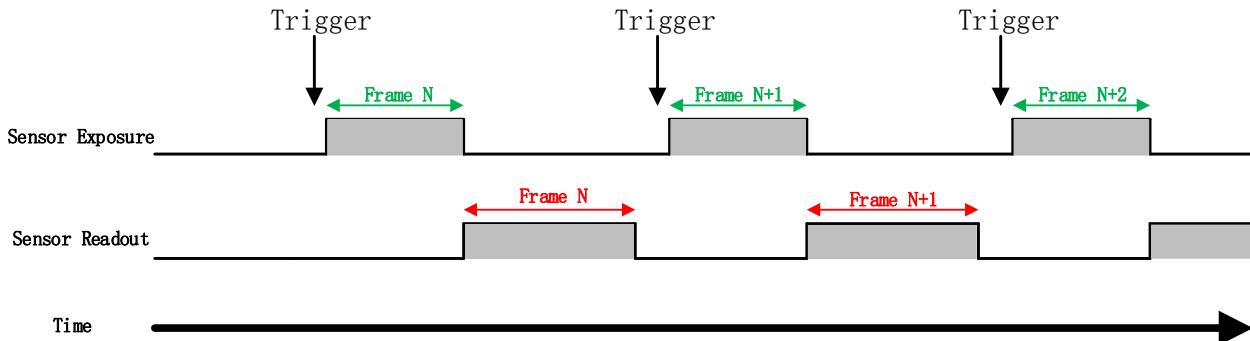
Figure2- 14: the trigger acquisition exposure sequence diagram in non-overlap exposure mode

● **Overlap exposure**

In overlap 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 Figure2- 15, when the N frame image is reading out, the N+1 frame image has been started exposure.

The formula of overlap exposure frame period:

overlap exposure frame period ≤ exposure time + readout time
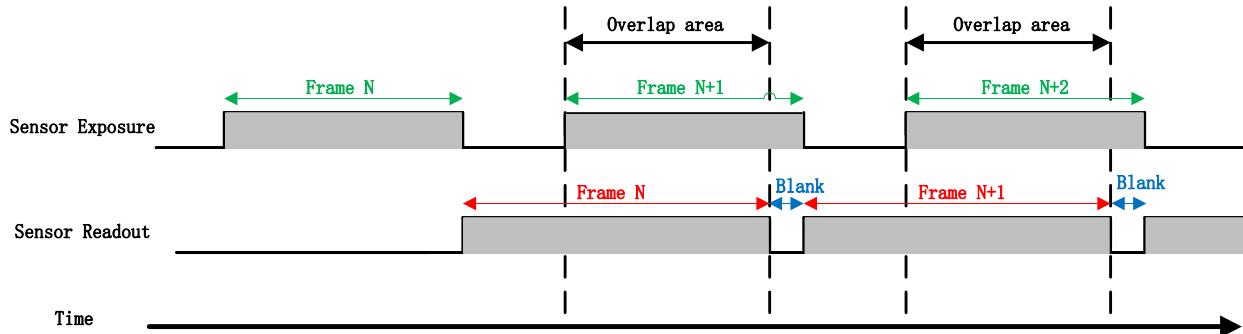
Figure2- 15: the exposure sequence diagram in overlap exposure mode

● **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 Figure2- 15.

● **Trigger acquisition mode in overlap exposure mode**

When the interval between two triggers is less than the sum of exposure time and the readout time, it will occur overlap exposure, as shown in Figure2- 16.
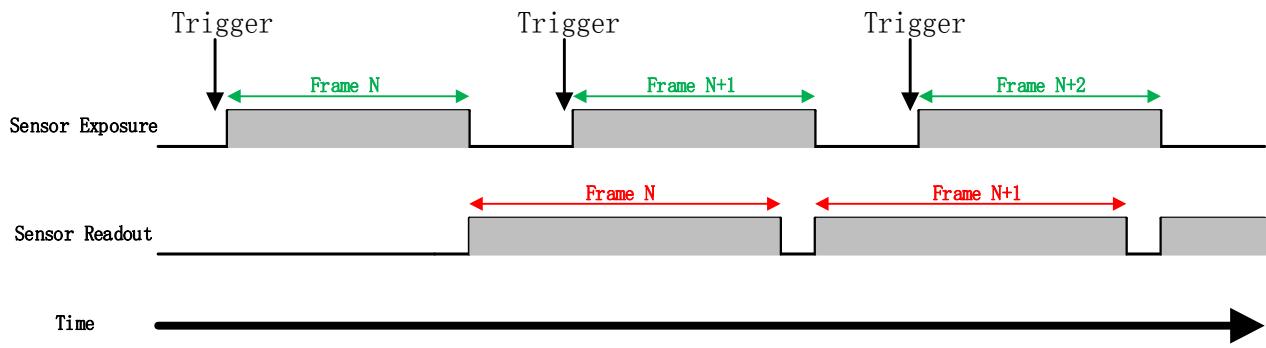
Figure2- 16: the trigger acquisition exposure sequence diagram in overlap exposure mode

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

2.3. Basic Features

2.3.1. Gain

The MARS-Gx-P series camera can adjust the analog gain, and the range of analog gain is as follows:

Model	Adjustment Range	Default/Steps
MARS-880-13Gx-P	0-24dB	0dB, 0.1dB
MARS-1230-9Gx-P	0-23.9dB	0dB, 0.1dB

Table2- 3:MARS-Gx-P series camera analog gain adjustment range

When the analog gain changes, the response curve of the camera changes, as shown in Figure2- 17. 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 as a way 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, as shown in the 2.3.6 section lookup table.

Note that increasing the analog gain or digital gain will amplify the image noise.
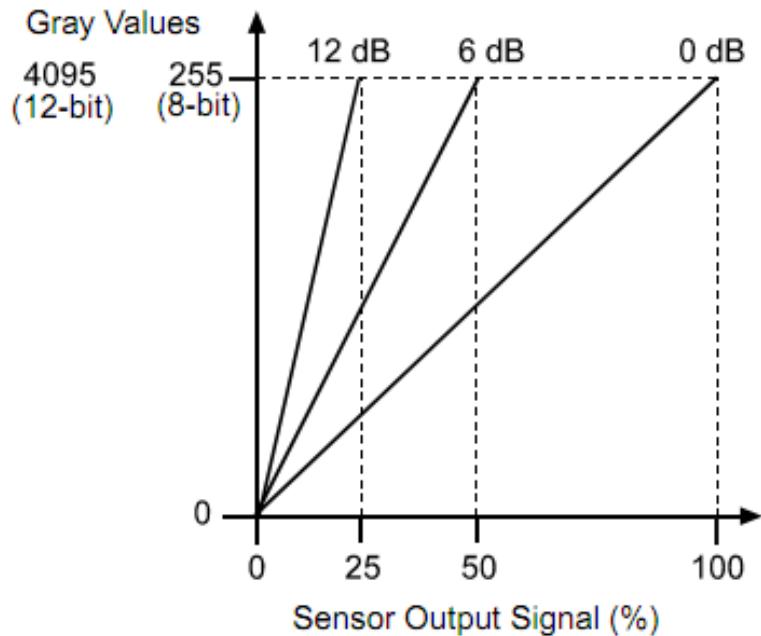
Figure2- 17: the cameras response curve

2.3.2. 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.

Model	Pixel Format
MARS-880-13Gx-P	Mono8, Mono12, BayerRG8, BayerRG12
MARS-1230-9Gx-P	Mono8，Mono12，BayerRG8，BayerRG12

Table2- 4: pixel format that the MARS-Gx-P series camera supported

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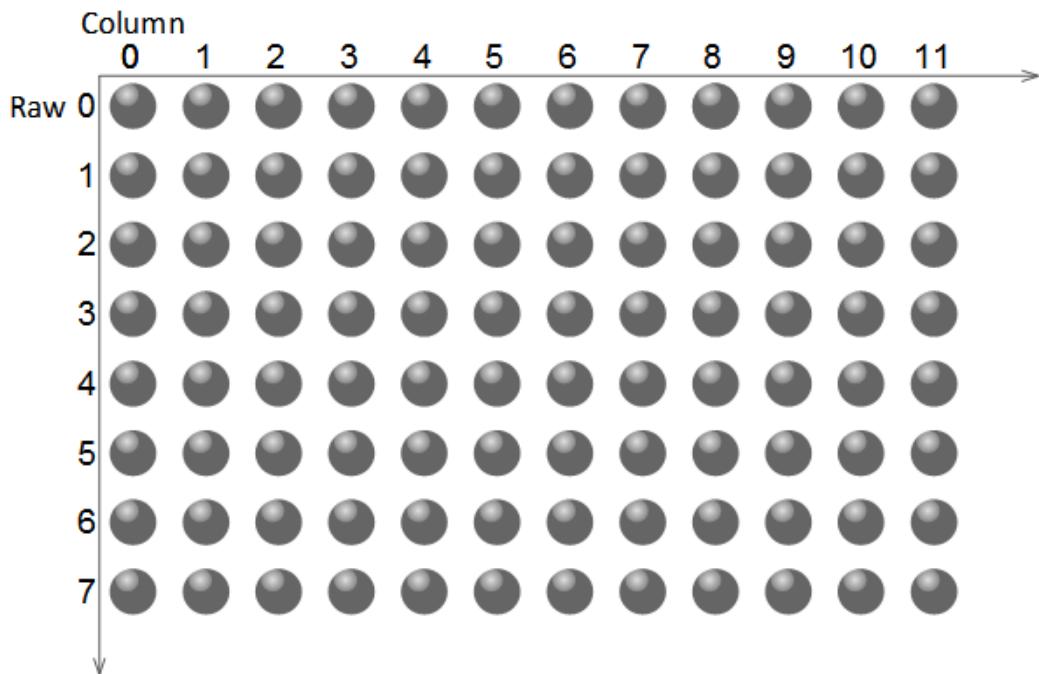
When the pixel format is set to Mono8, the brightness value of each pixel is 8bits. The format in the memory is as follows:

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 bit length. When Mono10 is selected, the effective data is only 10 bit, the six unused most significant bits are filled with zero. When Mono12 is selected, the effective data is only 12 bit, the 4 of the MSB 16 bit 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 8bits of brightness, and the second byte of each pixel is high 8bits of brightness.

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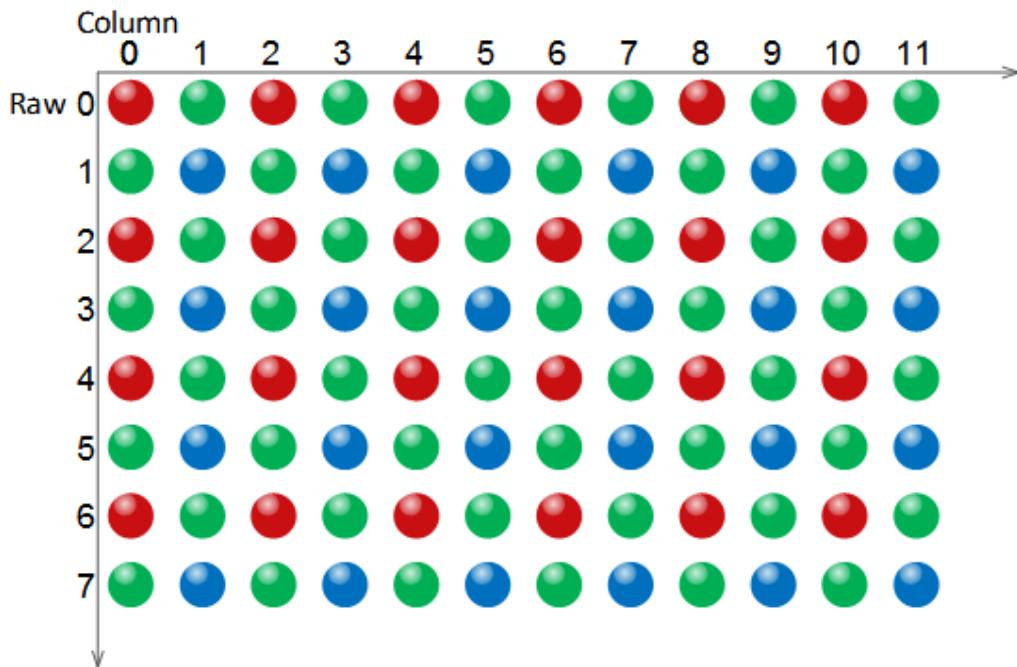
When the pixel format is set to BayerRG8, the value of each pixel in the output image of the camera is 8bits. According to the location difference, the three components of red, green and blue are respectively represented. The format in the memory is as follows:

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 16bits. 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 8bits of the pixel value, and the second byte is the high 8bits of the pixel value.

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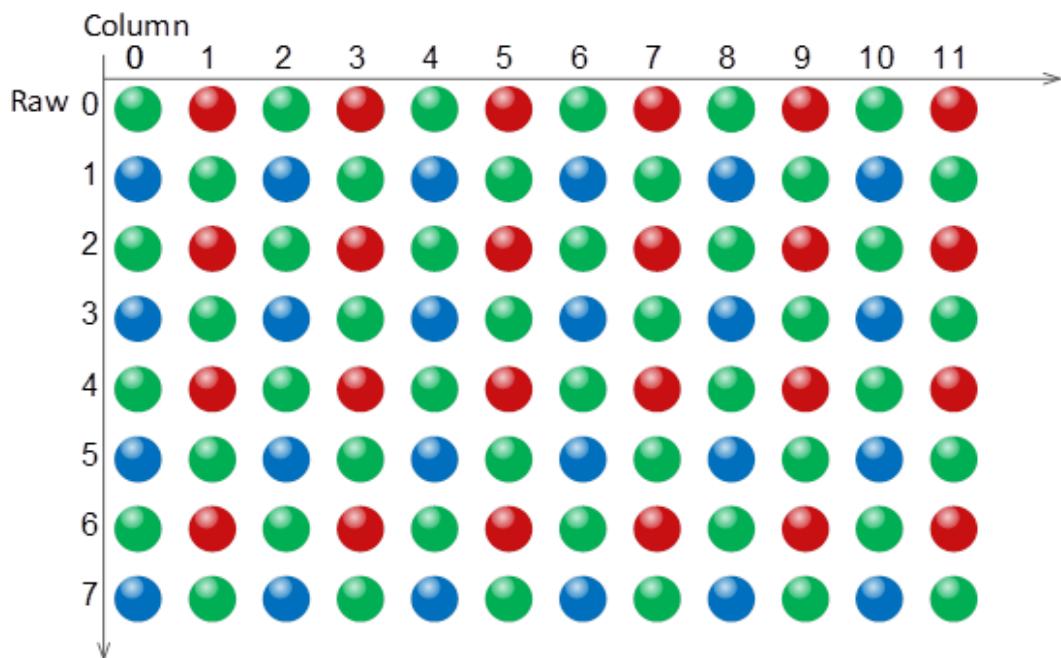
When the pixel format is set to BayerGR8, the value of each pixel in the output image of the camera is 8bits. According to the location difference, the three components of red, green and blue are respectively represented. The format in the memory is as follows:

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 16bits. 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 BayerGR8, the difference is that each pixel is made up of two bytes, the first byte is the low 8bits of the pixel value, and the second byte is the high 8bits of the pixel value.

2.3.3. 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.

The coordinates of the ROI of the image are defined the 0th line and 0th columns 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.
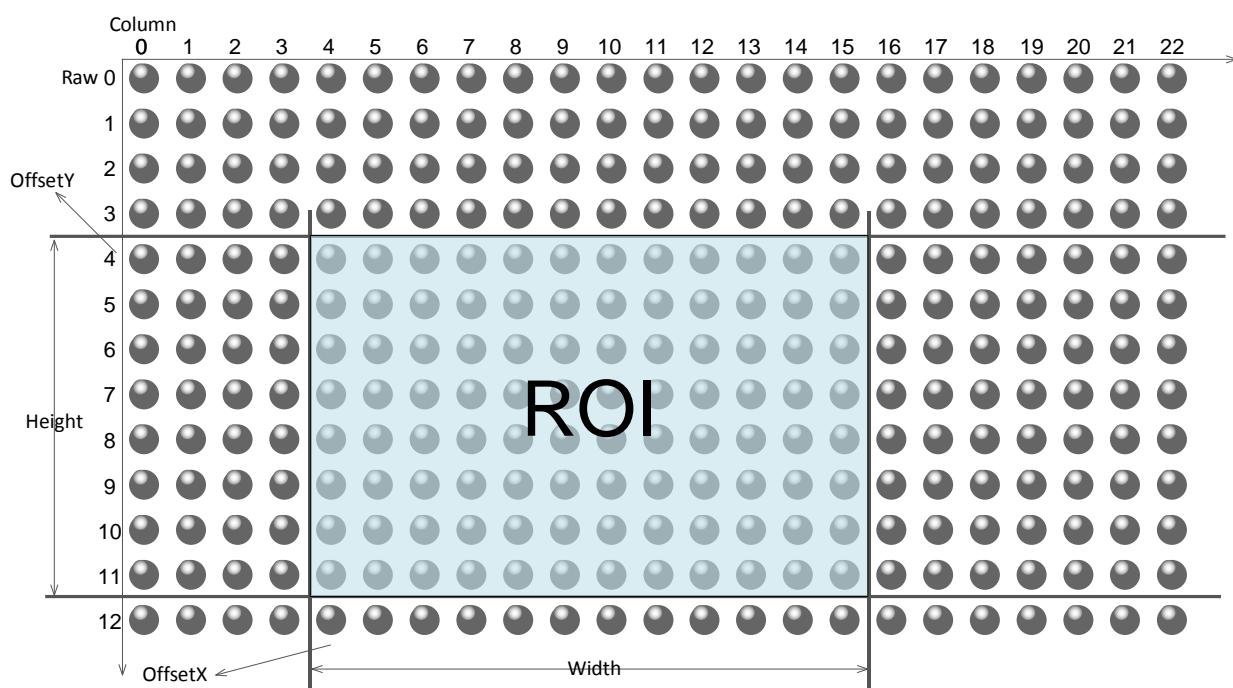
When reducing the height of the ROI, the maximum frame rate of the camera will be raised. Please refer to section 2.4.1 for specific effects on the acquisition frame rate.

2.3.4. Auto Exposure/Auto Gain

2.3.4.1. ROI setting of Auto Exposure/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 not meet the condition 1, 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 Figure2- 18.
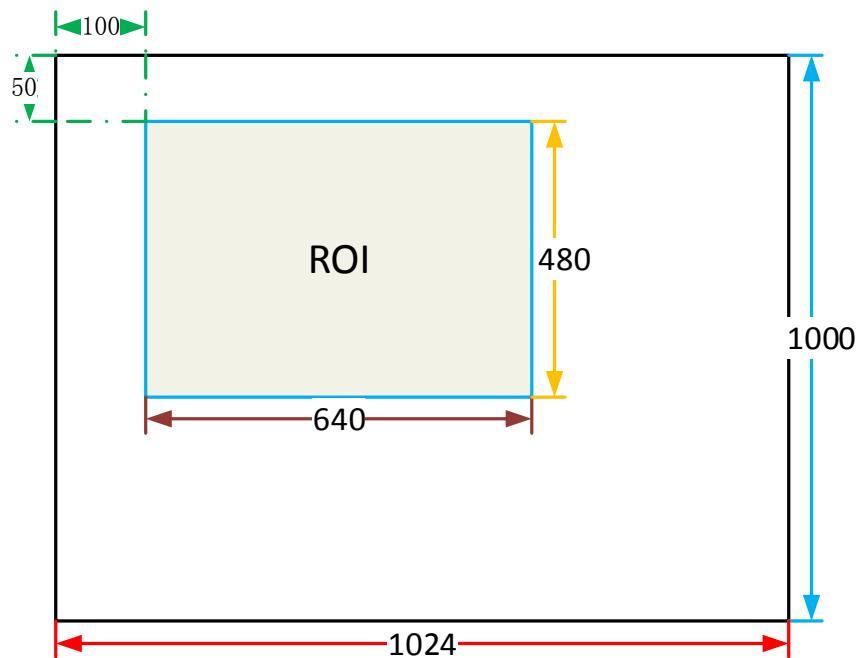
Figure2- 18: an example for the relative position between the ROI and the current image

2.3.4.2. Auto Gain

The auto gain function 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 function. 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 function 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.

2.3.4.3. Auto Exposure

The auto exposure function 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 function. 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 ROI 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 function 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.

2.3.5. Auto White Balance

2.3.5.1. Auto white balance ROI

Auto White Balance function use the image data from AWBROI to calculate the white balance ratio, and then 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 length of X axis direction offset and width is 4, the step length of Y axis direction offset and height is 2. The ROI setting depends on the current image and cannot exceed the current image range. That is to say, assuming the current image width is Width, the image height is Height, then the ROI setting need to meet the following condition 2:

$$AWBROIWidth + \ AWBROIOffsetX \leq Width$$

$$AWBROIHeight + \ AWBROIOffsetY \leq Height$$

If not meet the condition 2, the user cannot setting 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 condition2.

Assuming the current image width is 1024, the height is 1000, and then the "white dot" area ROI setting is:

$$AWBROIOffsetX = 100 ；$$

$$AWBROIOffsetY = 50 ；$$

$$AWBROIWidth = 640 ；$$

$$AWBROIHeight = 480 ；$$

The relative position of the ROI and the image is shown in Figure2- 19.
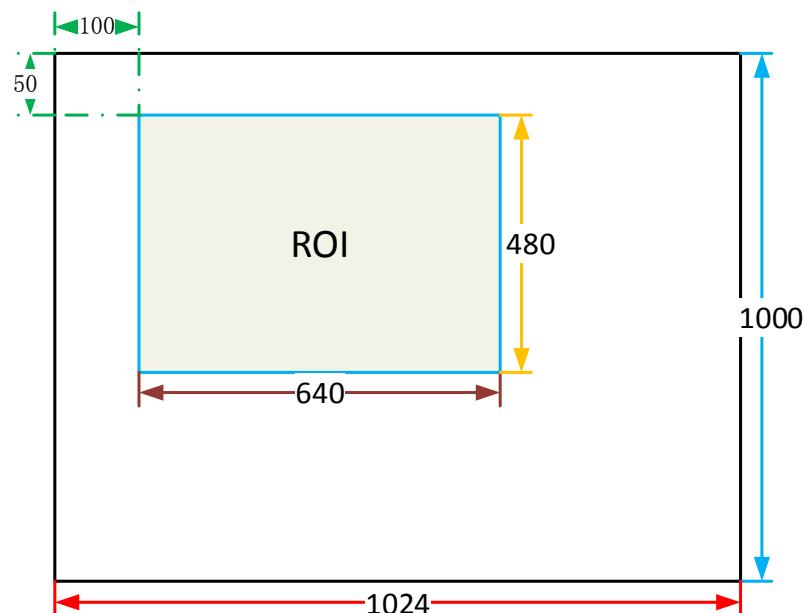
Figure2- 19: an example for the relative position between the ROI and the current image

2.3.5.2. Auto White Balance

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 only once, when using the "Continuous" mode, the camera continuously adjusts the white balance ratio based on the data in AWBROI.

The auto white balance function 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 coefficient 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.

The auto white balance function is only available on color sensors.

2.3.6. 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 8bits, there are 14bit, 12bit, 10bit and etc. When selecting the output data bit depth is 8bit, you should convert the 12bit data to 8bit data. The lookup table can implement the mapping from 12bit to 8bit.

The lookup table can be a linear lookup table or a non-linear lookup table. The typical linear lookup table implements the selection of 8 bits, and Figure2- 20 is an example of the linear lookup table choosing different 8bits.
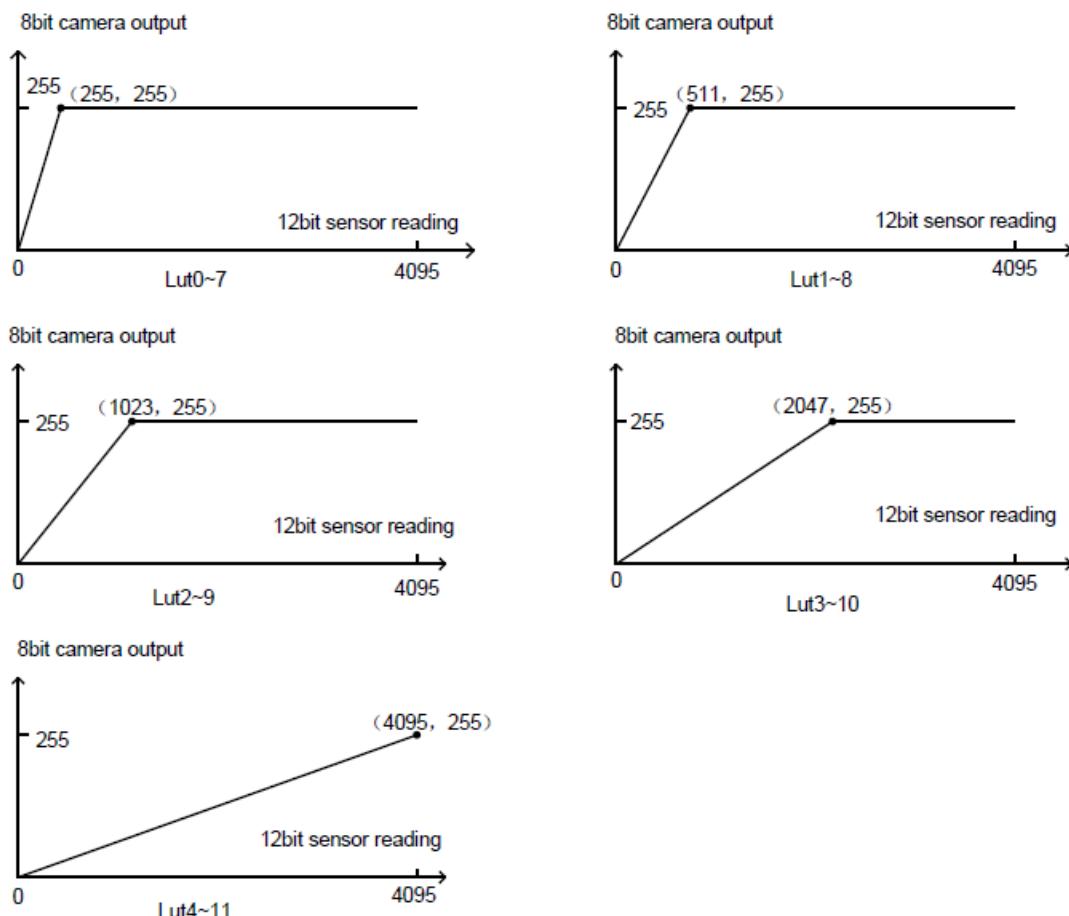
Figure2- 20: linear lookup table

As shown in the Figure2- 20, the 4-11, 3-10, …, 0-7 represents the data bits which is selected, and 4-11 is the high 8 bits of 12 bits data. The curvature of the curve increases by a multiple of 2, and the brightness of the image increases with a multiple of 2, at the same time the noise increases.

Non-linear lookup table such as gamma, contrast, brightness, etc., the lookup table tool can produce this type of lookup table. The user can also create a lookup table by dragging the curve according to his own requirements. Figure2- 21 is an example of a non-linear curve.
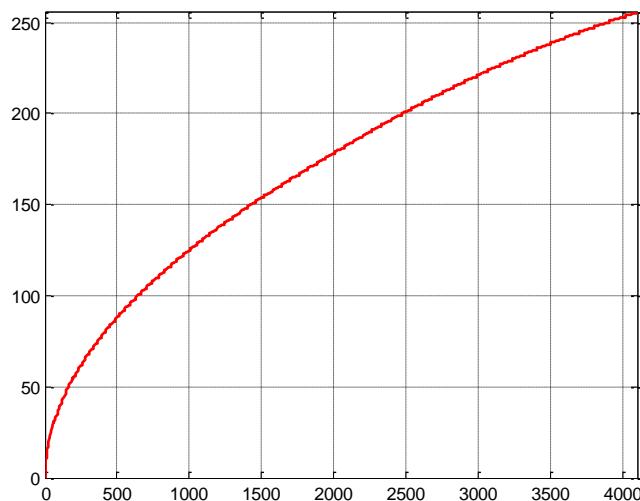
Figure2- 21: Non-linear lookup table

2.3.7. TestPattern

The MARS-Gx-P series camera supports three test images: gray gradient test image, moving horizontal gray gradient test image, and moving diagonal gray gradient test image. When the camera captures in Raw12 mode, the gray value of test image is: the pixel gray value in Raw8 mode multiplies by 16, as the output of pixel gray value in Raw12 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 Figure2- 22:

Figure2- 22: gray gradient test image

- **moving horizontal gray gradient test image**

In the moving horizontal gray gradient test image, the gray value of pixels in each column of the image are equal, each pixel in each row increases by 1, from left to right, until the gray value is 255, then the next gray value returns to 0.

In the moving horizontal gray gradient test image, in the adjacent frame, the first column 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 horizontal gray gradient test image is shown in Figure2- 23:

Image rolling direction
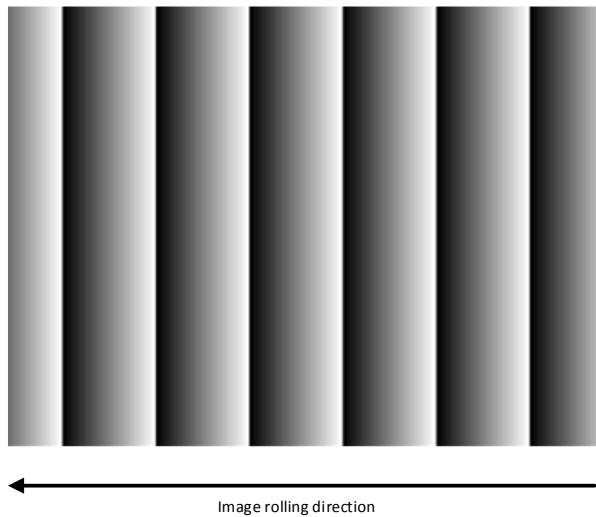
Figure2- 23: moving horizontal gray gradient test image

- **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 Figure2- 24:
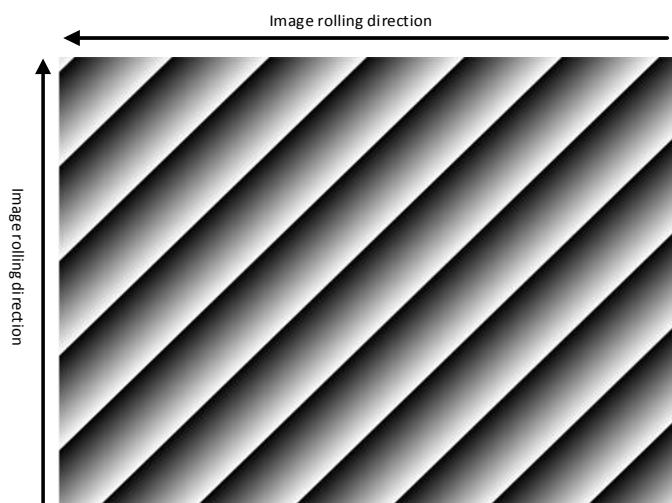
Figure2- 24: moving diagonal gray gradient test image

2.3.8. 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 MARS-Gx-P series 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 a vendor default configuration parameters or a 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 manufacturer' default configuration parameters are the camera configuration parameters optimized by the manufacture 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 MARS-Gx-P series 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 startup parameter set.

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

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

b)   Use UserSetSelector to select UserSet0.

c)   Execute UserSetSave command.

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

- Gain

- ExposureTime

- TransferControlMode

- PixelFormat

- OffsetX, OffsetY, ImageWidth, ImageHeight

- GevSCPSPacketSize, GevSCPD

- EventNotification

- TriggerMode, TriggerSource, TriggerPolarity, TriggerDelay

- TriggerFilterRaisingEdge, TriggerFilterFallingEdge

- LineMode, LineInverter, LineSource, UserOutputValue

- FrameBufferOverwriteActive

- 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:

a) Use UserSetSelector to select Default or UserSet0.

b) Execute UserSetLoad command to load the User Set 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 startup parameter set. When the camera is reset or powered on again, the parameters in the startup parameter set will be loaded into the effective configuration parameters.

2.3.9. DeviceUserID

The MARS-Gx-P series camera provides programmable user-defined name 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 **IPConfigTool**, for more details please see the section 4.1.2.4 Configuration IP address:
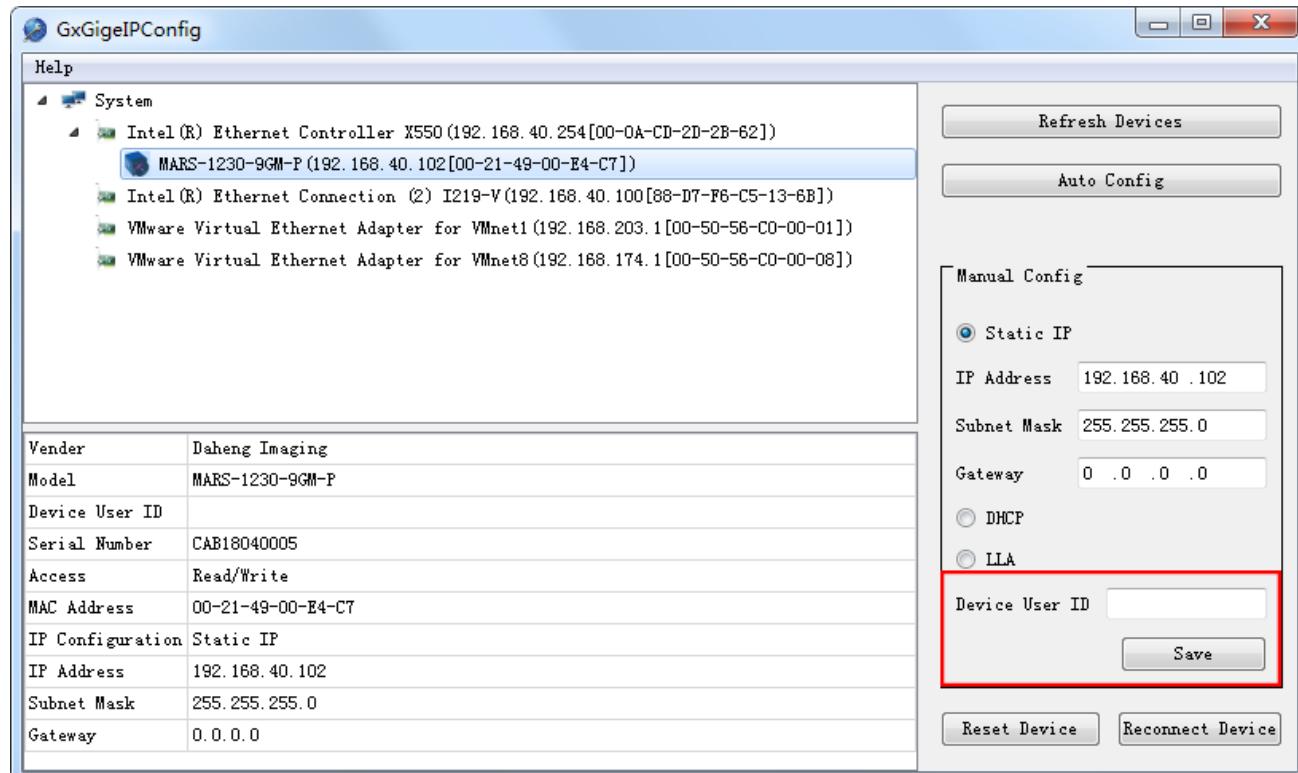
Figure2- 25: IPConfigTool

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.

2.4. Image Transmission

2.4.1. The Maximum allowable frame rate

1) The maximum allowable frame rate of the network

The maximum allowable frame rate of the network is the camera's maximum transmission frame rate that the current network supports. The maximum frame rate that the MARS-Gx-P series camera network supports is determined by the camera's resolution, pixel format (Pixle Size), and the valid network bandwidth. It is can be expressed by the formula:

The maximum allowable frame rate of the network = the valid network bandwidth/ resolution/ Pixle Size

Example 1: The camera resolution is 1628*1236, the pixel format is BayerRG8, packet size is 1500 bytes, and packet delay is 1000. The current valid network bandwidth is 468Mbps.

The maximum allowable frame rate of the network = 468Mbps / (1628*1236)/8 = 29 fps

In addition to the limitations of network bandwidth, the maximum working frame rate of the camera is affected by the following two factors:

● Usually, the camera front-end sensor readout time and the camera internal transfer time is called the camera acquisition time. The camera acquisition time is affected by the ROI which is set by the user.

● The camera's exposure time.

2) The calculation of the camera's acquisition time

The camera's acquisition time is related to the OffsetY and the height of the ROI. When the OffsetY and height of the ROI is changed, it will affect the front-end acquisition frame period of the camera, then affect the acquisition frame rate.

3) The camera's acquisition frame rate

In addition to the maximum allowable bandwidth of the network and the time limit for camera acquisition, the exposure time can also affect the frame rate. For example: for MARS-1230-9Gx-P camera, when the exposure time is 200ms, the corresponding frame rate is 5fps.

To sum up, the frame rate of the camera takes the minimum of the maximum allowable frame rate, the acquisition frame rate and the exposure frame rate.

2.4.2. Stream Channel Packet Size

Stream channel packet size refers to the network packet's size of the stream channel data which is transferred to the host terminal by the camera, in bytes and the default value is 1500. It includes the IP header, UDP header and GVSP header which the total length is 36 bytes, so the payload in the default channel network packet is 1464 bytes. The recommended maximum packet length is 8192 bytes, which can improve the network transmission performance.

1) When the packet size is set more than 1500, it need the network equipment such as network card and switch to support the jumbo frames.

2) When changing the packet size, the packet size and the packet delay will affect the network transfer performance together.

2.4.3. Stream Channel Packet Delay

The stream channel packet delay (SCPD) is used to control the bandwidth of the image streaming data of the camera. The packet delay is the number of the idle clocks that inserted between adjacent network packets transmitted in the stream channel. Increase the packet delay can reduce the camera's bandwidth usage, and it may also reduce the camera's frame rate (the camera frame rate also depends on the exposure time, camera acquisition time).

The camera's packet size, packet delay and reserved bandwidth determine the effective network bandwidth. The effective network bandwidth is calculated as follows:

The time required to transmit a single stream packet:

$$\mathrm{T}_{data} = \left(Size_{pkt} \times 8bits\right)/Speed_{link}$$

The time of packet delay is:

$$T_{delay} = Delay_{pkt}/125,000,000$$

Among them: the $Size_{pkt}$ is packet size, $Delay_{pkt}$ is packet delay, $\mathrm{BandW}_{reserve}$ is reserved bandwidth, $Speed_{link}$ is connection speed.

Effective network bandwidth:

$$\mathrm{BandW}_{avial} = (Size_{pkt} \times 8bits \times (1 - \mathrm{BandW}_{reserve})/(T_{data} + T_{delay})$$

Example 1: The packet size is set to 1500, the packet delay is 1000, the reserved bandwidth is 20%, and the connection speed is 1Gbps.

The time to transport a single stream packet is:

$$T_{data} = (1500 \times 8)/1000,000,000 = 12us$$

The time of packet delay is:

$$T_{delay} = 1000/125,000,000 = 8us$$

The effective network bandwidth is:

$$\mathrm{BandW}_{avial} = (1464 \times 8 \times (1 - 0.2))/(12us + 8us) = 468Mbps$$

Notice: Each stream packet contains 36 bytes of network header data, and a packet with the size of 1500 bytes contains only 1464 bytes of valid data.

Example 2: The packet size is set to 8192, the packet delay is 2000, the reserved bandwidth is 20%, and the connection speed is 1Gbps.

The time to transport a single stream packet is:

$$T_{data} = (8192 \times 8)/1000,000,000 = 66us$$

The time of packet delay is:

$$T_{delay} = 2000/125,000,000 = 16us$$

The effective network bandwidth is:

$$\text{Band}W_{avial} = (8156 \times 8 \times (1 - 0.2))/(66us + 16us) = 637Mbps$$

2.4.4. Bandwidth Reserve

The reserved bandwidth (Bandwidth Reserve) is used to reserve a part of bandwidth for packet retransmission and control data transfer between the camera and the host, and also can be used for multiple cameras transmission, to limit the bandwidth allocation of each camera. For example, the network bandwidth is 1Gbps, setting the reserved bandwidth value of 20%, then the bandwidth will be set aside 0.2Gbps. When the maximum bandwidth required for transmission is greater than the current bandwidth available, the camera reduces the frame rate to ensure the stability of the transmission.

2.4.5. Frame Transfer Control

When multiple cameras are connected to the host by switches, if trigger these cameras to acquire images at the same time, when transmitting the images, because of the instantaneous bandwidth of the switch is too large, and the storage capacity is limited, data loss will occurs. Therefore, the user need to use frame transfer delay to avoid this problem.

In trigger mode, by setting the Transfer Control Mode as "User Controlled", when the camera receives software trigger command or external trigger signal and completes the image acquisition, the camera will save the images in the frame buffer which is internal the camera, waiting for the host to send the "Acquisition Start" command, the camera will transmit the images to the host. The transmission delay time is determined by the host. When multiple cameras are triggered simultaneously, different transmission delay can be set for each camera to avoid the instantaneous bandwidth of the switch is too large.

⚠️ The frame transmission delay function is valid only in trigger mode.

2.5. 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 MARS-Gx-P series camera, the camera can generate and transmit events for the following types of 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 event queue is overflow(EventOverrun)

Every event has a corresponding enable status, and in default all the events' enable status are disable.

When using the event function, you need to enable the corresponding event firstly and set the port of the event channel, the timeout of the event retransmission, and the number of times the event resends to the camera. When the retransmission timeout of the event is set to 0, the event sent by the camera will not require the host to return the reply packet. When the port value of the event channel is set to 0, the camera will not send the event to the host. In other cases, the camera needs to receive a host reply package before sending the next event. When the event that the camera sends does not receive the reply packet, the camera will retransmit the event according to the retransmission timeout and retransmission times set.

The effective information contained in each event is shown in Table2- 5:

No.	Event Type	Information
1	ExposureEnd Event	Event ID
		Frame ID
		Timestamp
2	BlockDiscard Event	Event ID
		Timestamp
3	EventOverrun Event	Event ID
		Timestamp
4	FrameStartOvertrigger Event	Event ID
		Frame ID
		Timestamp
5	BlockNotEmpty Event	Event ID
		Timestamp

Table2- 5: 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 64bits, and the unit is 20ns.

2.5.1. ExposureEnd Event

If the ExposureEnd Event is enable, 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.

2.5.2. 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 an image frame data discarding event to the host, indicating that once image discard event has occurred. So when you read the next frame, the image is not continuous.

2.5.3. BlockNotEmpty Event

When the average bandwidth of the read-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 Frame Buffer not Empty 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.

2.5.4. FrameStartOvertrigger Event

When the camera receives the external trigger signal or software trigger signal, if the front-end sensor is exposing, it will not be able to respond to the new trigger signal, then the camera will send a trigger signal overflow event to the host. Note that if multiple trigger signals are received within a frame period, the camera sends only one trigger signal overflow event.

2.5.5. EventOverrun Event

Inside the camera, there has an event queue which is used for caching events. Usually, the event data packet which is sent to the host only contains one event. When there are multiple events occur simultaneously, or when the event transmission is delay, the user can use event queue inside the camera to cache the events. When an event can be sent, the camera will send all the events cached in the queue, at this time the event data packet which is sent to the host contains multiple events. But if the camera is running in a high frame rate mode, and send a number of events that exceed the camera cache, at this time, if the event queue overflow event is enable, the camera will send an event queue overflow event to the host, and discard all the events in the current cache.

3. Electrical Interface
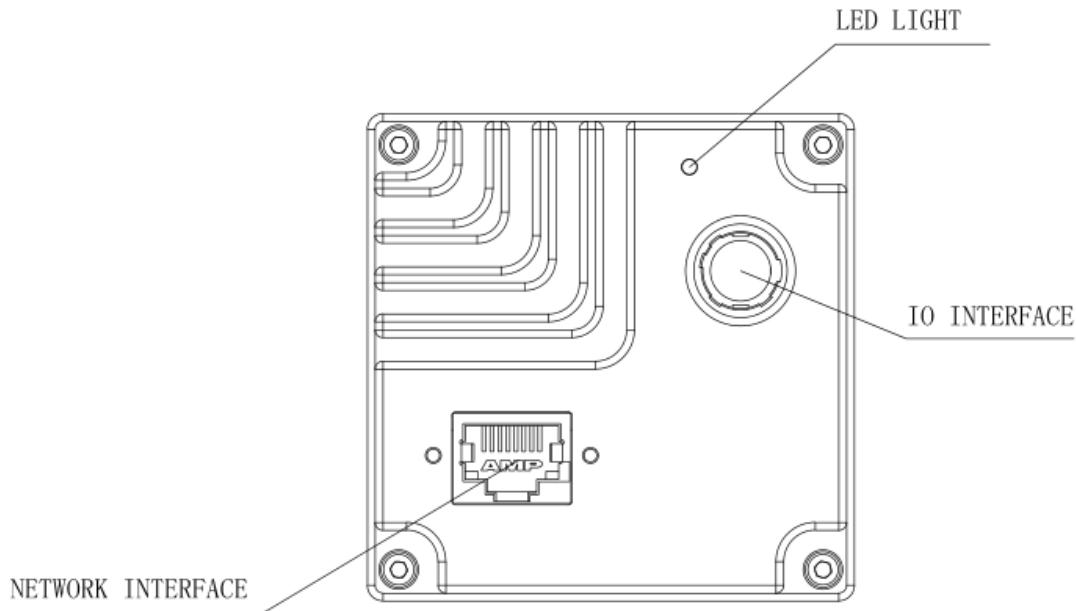
The electrical interface contains three parts: network interface, led light and I/O interface. The camera exchange data with the host by the network interface; the control signal's input/output, and power supply of the camera are all realized by the I/O interface. The LED light is used to indicate the working state of the camera.

3.1. Network Interface

Ethernet connector is a standard RJ45 socket, and the pin definition follows the Ethernet standard.

Ethernet port supports 100M Cat5e or Cat6 series cable.

Power can be supplied to the camera (MARS-Gx-P series) via Power over Ethernet (PoE), i.e., via the Ethernet cable plugged into the camera's RJ-45 connector.

3.2. LED Light

An LED light is set on the back cover of camera which indicates camera's status, as shown in Table3- 1 . LED light can display 3 colors: red, yellow and green.

LED status	Camera status
Off	The camera is powered off
Green constant light	Ethernet is connected but no data is being transmitted.

Green flash	Data is being transmitted through Ethernet.
Else	Internal conditions of the camera.

<div align="center">Table3- 1: camera status</div>

3.3. I/O Port

I/O port is implemented by Hirose 12-pin receptacle (part No. HR10A-10R-12PB(71)), and the corresponding plug is HR10A-10P-12S(73).

Diagram	Pin	Definition	Core Color	Description
	1	Line0+	Green	Opto-isolated input +
	2	GND	Blue	PWR GND & GPIO GND
	3	Line0-	Grey	Opto-isolated input -
	4	POWER_IN	Purple	Camera external power, +12V DC~+24V DC
	5	Line2	Orange	GPIO input/output
	6	Line3	Pink	GPIO input/output
	7	Line1-	White Green	Opto-isolated output -
	8	Line1+	White Blue	Opto-isolated output +
	9	NC1	White Grey	Not Connected, Reserved
	10	GND	White Purple	PWR GND & GPIO GND
	11	NC2	White Orange	Not Connected, Reserved
	12	NC3	White Pink	Not Connected, Reserved
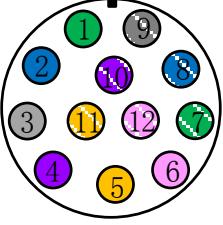
<div align="center">Table3- 2:   I/O port definition (back sight of camera)</div>

The input power of MARS-Gx-P series digital camera must be +12V ~ +24VDC (±10%) when supplied by I/O port.

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

3.3.1. Line0 (Opto-isolated input) circuit

Hardware schematics of opto-isolated input circuit is shown as
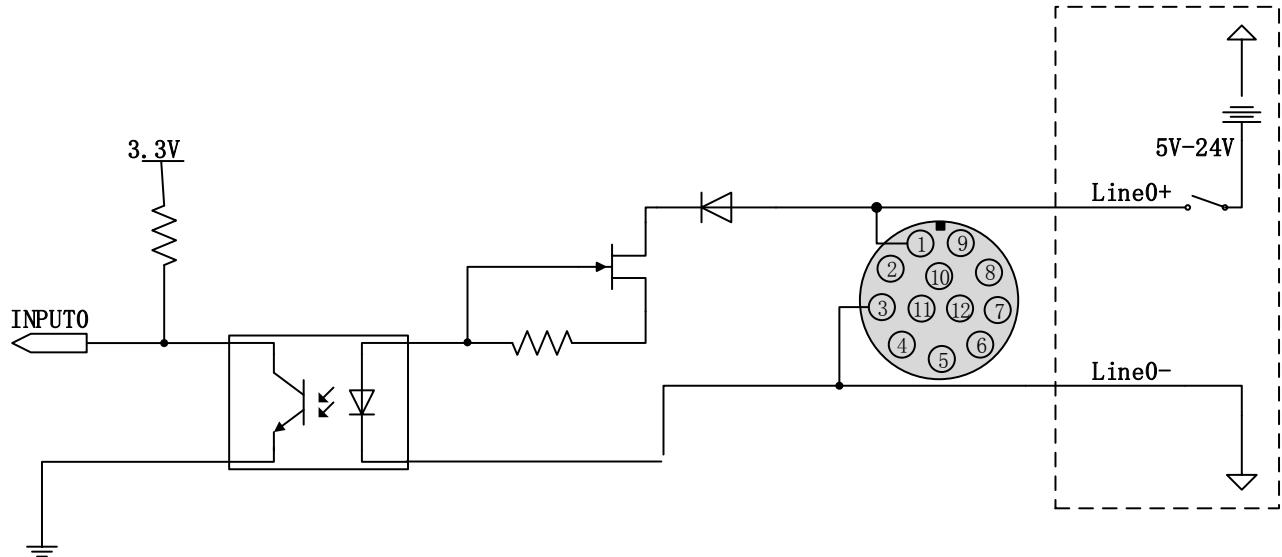
Figure3- 1 and the dashed box is external.
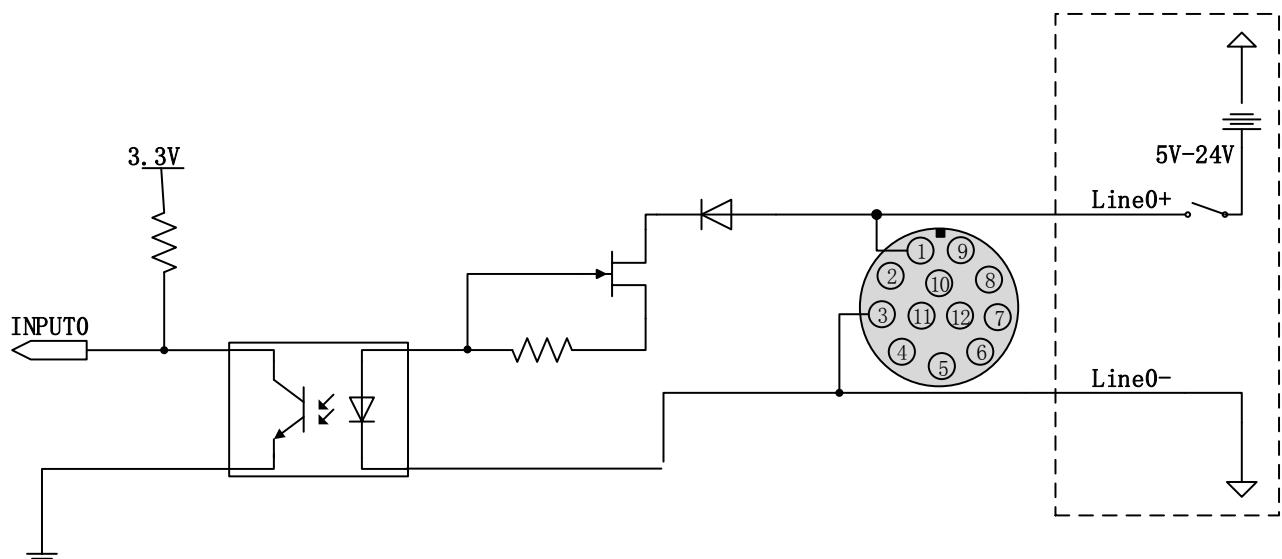
Figure3- 1: Opto-isolated input circuit

- Logic 0 input voltage: 0V~+2.5V (Line0+ voltage).

- Logic 1 input voltage: +5V~+24V (Line0+ voltage).

- Maximum input current: 7mA.

- The status is unstable when input voltage is between 2.5V and 5V, which should be avoided.

- When peak voltage of input signal over 9V, a current limiting resistor is recommended to protection the input line. The recommended resistance is shown in Table3- 3.

Line0+ input Voltage	Circuit-limiting Resistance Rlimit
9V	680Ω
12V	1kΩ
24V	2kΩ

Table3- 3: Circuit-limiting resistor value

● Rising edge delay: <50μs (0°C~45°C), parameter description as shown in Figure3- 2.

● Falling edge delay: <50μs (0°C~45°C), parameter description as shown in Figure3- 2.

● Different environment temperature and input voltage have influence on delay time of opto-isolated input circuit. Delay time in typical application environment (temperature is 25°C) is as shown in Table3- 4.

Parameter	Test condition	Value (us)		
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

Table3- 4: Delay time of opto-isolated input circuit in typical application environment
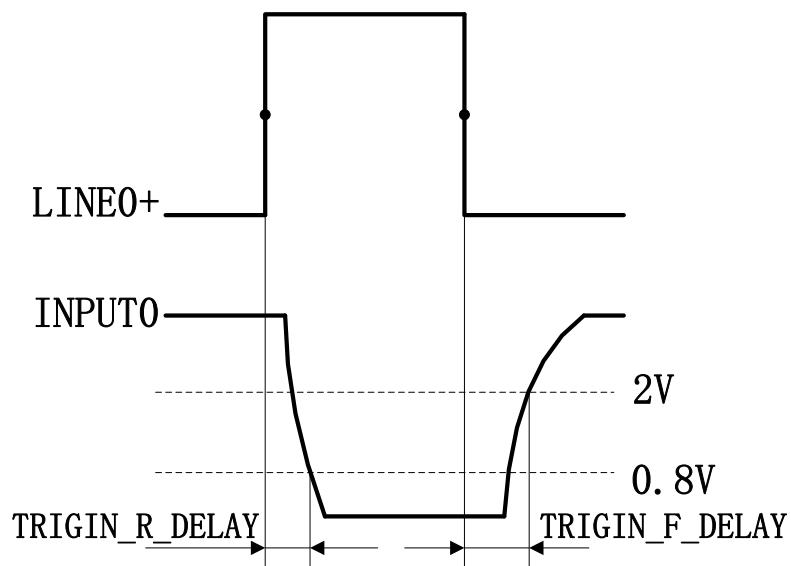
Figure3- 2: Parameter of opto-isolated input circuit

● 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+.

3.3.2. Line1 (Opto-isolated output) circuit

Hardware schematics of opto-isolated output circuit is shown as
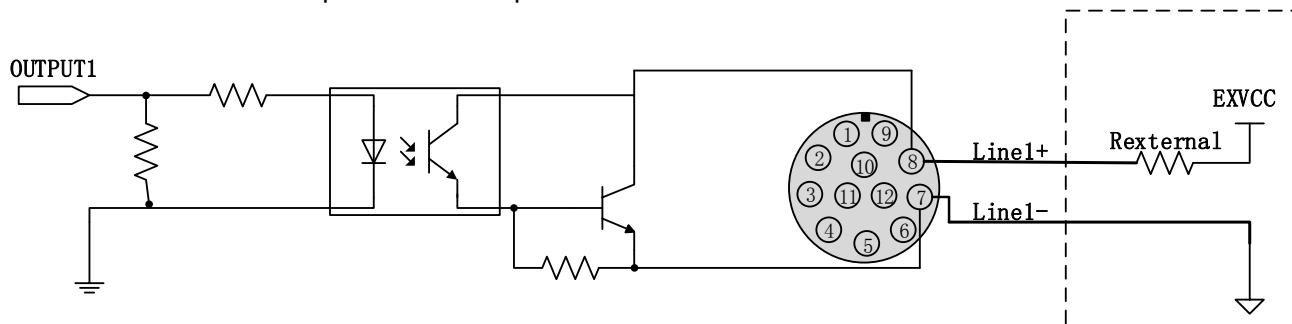
Figure3- 3 and the dashed box is external.
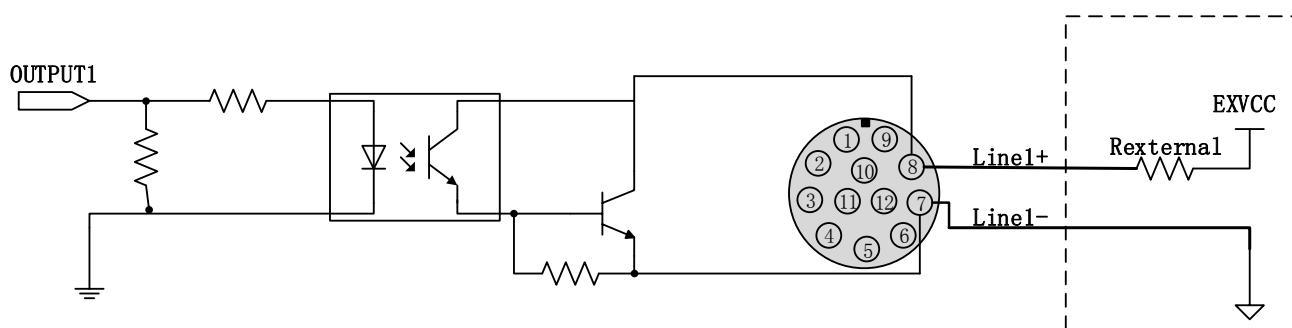
Figure3- 3: Opto-isolated output circuit

- Range of external voltage (EXVCC) is 5~24V.

- Maximum output current of Line1 is 25mA.

- Output voltage and output current of opto-isolated output circuit in typical application environment (temperature is 25°C) is as shown in Table3- 5.

External voltage EXVCC	External resistance Rexternal	Output voltage (V)	Output current (mA)
5V	1kΩ	0.90	4.16
12V	1kΩ	0.97	11.11
24V	1kΩ	1.04	23.08

Table3- 5: Output voltage and output current of opto-isolated output circuit in typical application environment

- Rising time delay = tr+td：<50μs (0°C~45°C) (parameter description is shown in Figure3- 4).

- Falling time delay = ts+tf：<50μs (0°C~45°C)(parameter description is shown in Figure3- 4).

- Delay time in typical application conditions (environment temperature is 25°C) are shown in Table3- 6.

Parameter	Test Condition	Value (us)		
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 = tr+td		4.70	~	13.76
Falling time delay = tf+ts		14.41	~	24.38

Table3- 6: Delay time of opto-isolated output circuit in typical application environment
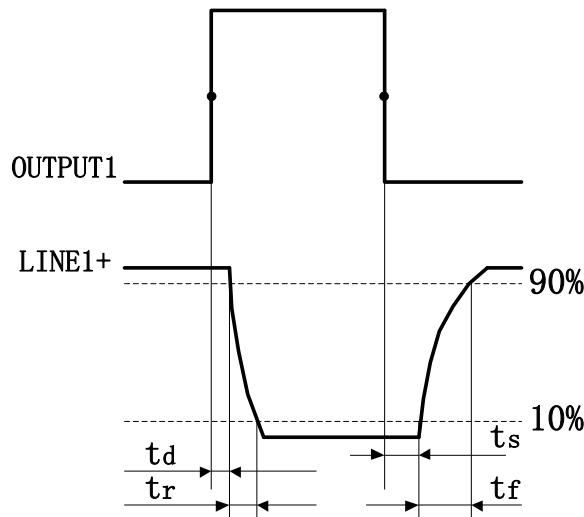
Figure3- 4: Parameter of opto-isolated output circuit

● 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.

3.3.3. GPIO 2/3 (bidirectional) circuit
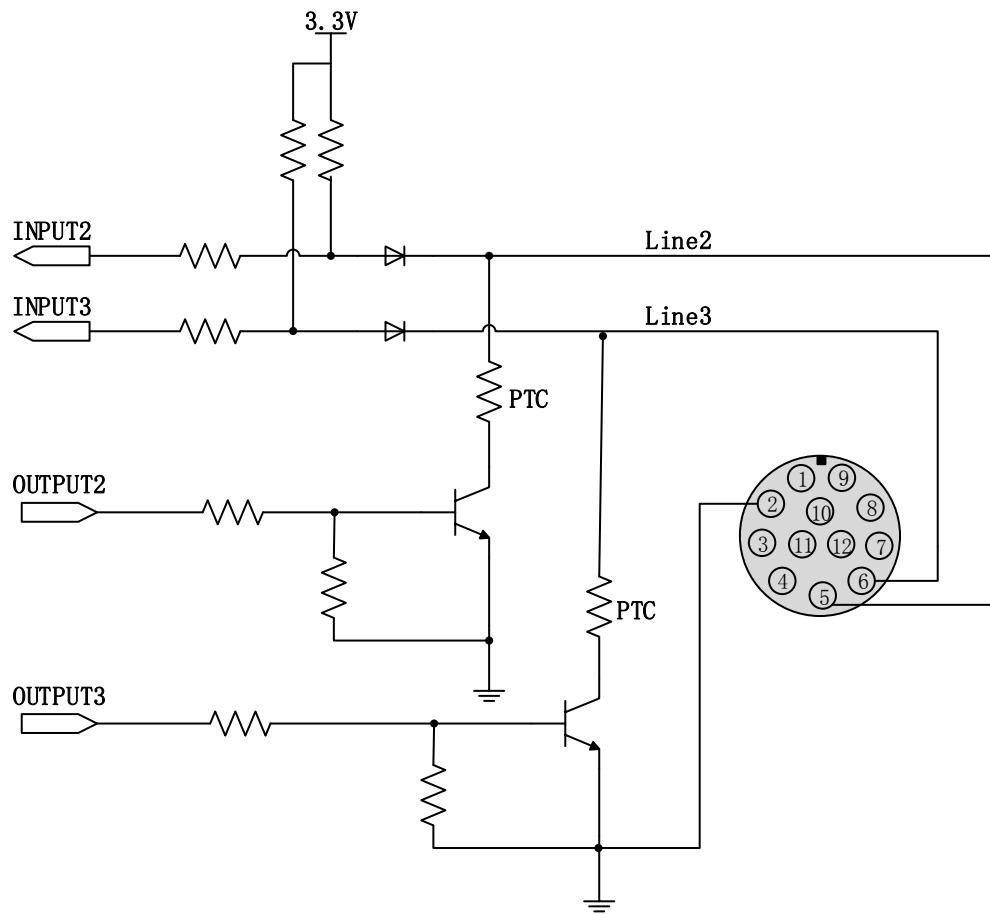
Figure3- 5:   GPIO 2/3 (bidirectional) circuit

3.3.3.1. Line2/3 is configured as input

- 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 100uA; when input of Line2/3 is low, input current is lower than -1mA.

- When LINE2/3 is configured as input, if the corresponding output device is common-anode connected, 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 Figure3- 2.

- Input falling time delay: <2µs (0°C~45°C) , parameter description as shown in Figure3- 2.

- When Line2/3 is configured as input, the internal equivalent circuit of camera is shown in Figure3- 6, taking Line2 as an example.
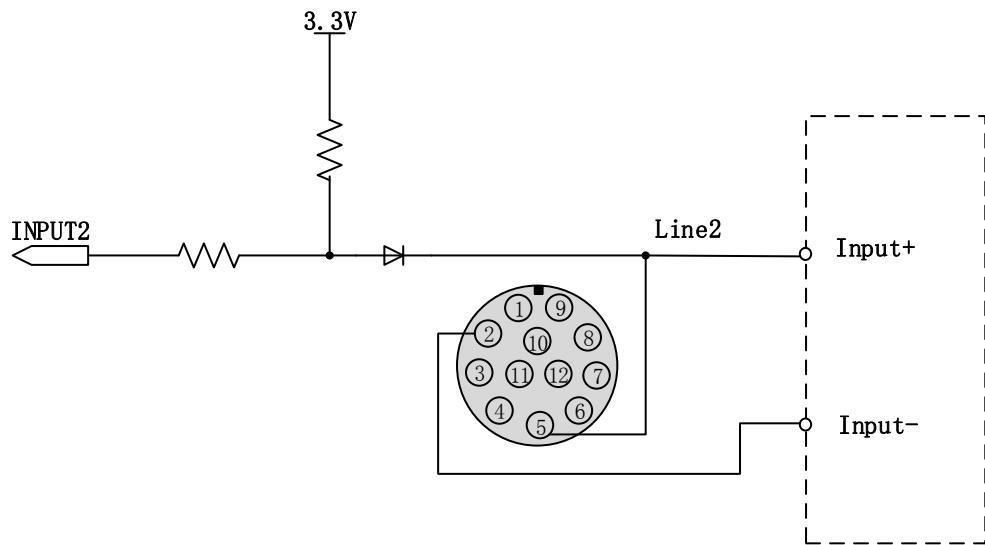
Figure3- 6: Internal equivalent circuit of camera when Line2 is configured as input

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

3.3.3.2. 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.

- Output voltage and output current in typical application conditions (temperature is 25° C) are shown in Table3- 7.

External voltage EXVCC	External resistance External	Line2/3 voltage (V)	Output current (mA)
5V		0.19	4.8
12V	1kΩ	0.46	11.6
24V		0.92	23.1

Table3- 7: Voltage and output current of Line2/3 in typical conditions

- Rising time delay = tr+td: <20μs (0°C~45°C) (parameter description as shown in Figure3- 4).

- Falling time delay = ts+tf: <20μs (0°C~45°C) (parameter description as shown in Figure3- 4).

- Delay parameters are affected greatly by external voltage and resistance, but little by temperature. Output delays in typical application conditions (temperature is 25°C) are shown in Table3- 8.

Parameter	Test Conditions	Value (us)		
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 = tr+td		0.19	~	0.26
Falling time delay = tf+ts		1.97	~	2.09

Table3- 8: Delay time when GPIO is configured as output in typical conditions

- When Line2/3 is configured as output, the internal equivalent circuit of camera is shown in Figure3- 7, taking Line2 as an example.
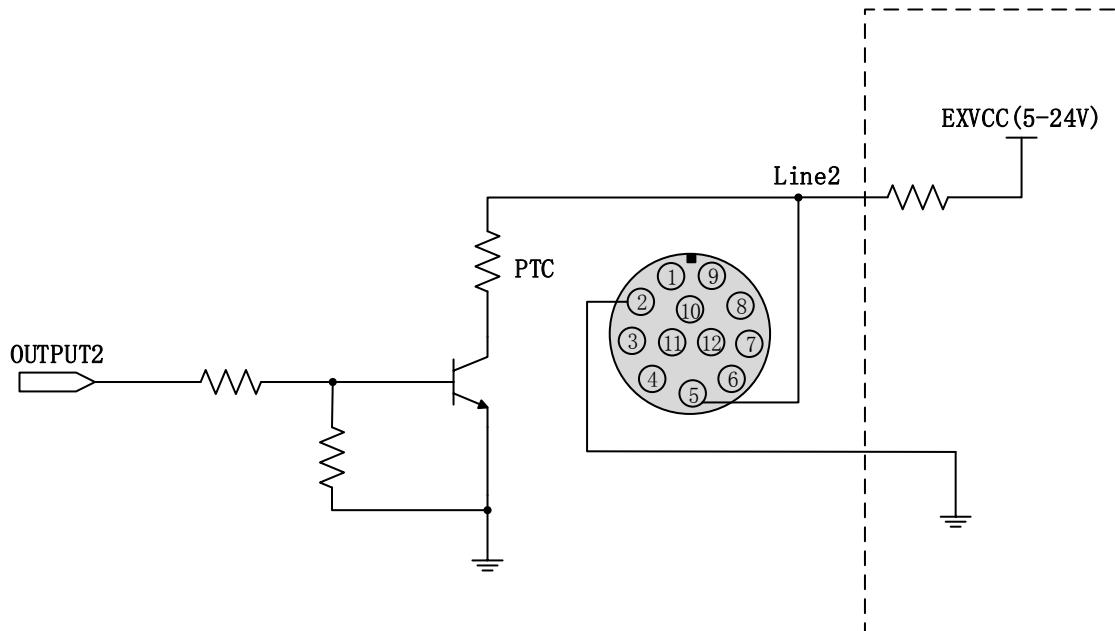
Figure3- 7: Internal equivalent circuit of camera when Line2 is configured as output

3.4. MARS-Gx-P series Camera Power

MARS-Gx-P series camera can get power in either of two different ways:

- Via Power over Ethernet (PoE), i.e., via the Ethernet cable plugged into the camera's RJ-45connector.

- From a power supply via an I/O cable plugged into the Hirose 8-pin receptacle.

- Nominal operating voltage of a power supply is +12 V ~ +24VDC (± 10%).

When you supply power to the camera both via the camera's RJ-45 jack and via the Hirose 8-pin receptacle, camera will get power from the Hirose 8-pin receptacle. And then you cut off power supply via the Hirose 8-pin receptacle, camera will get power via PoE and possibly restart.

3.4.1. Via PoE

If you are supplying power via PoE, the power provided must adhere to the requirements specified

in IEEE 802.3af.

Power consumption is as shown in the specification tables in Section1.2 of this manual.

3.4.2. From a Power Supply to the Hirose 8-pin receptacle

Camera can get power from the Hirose 8-pin receptacle via a standard I/O cable.

Nominal operating voltage is +12V~+24VDC (± 10%). Power consumption is as shown in the specification tables in Section1.2 of this manual.

Voltage outside of the specified range can cause damage.
The plug on the cable that you attach to the Hirose 8-pin receptacle must have 8 female pins. Using a plug designed for a smaller or a larger number of pins can damage the connector

4. Software Application

4.1. GigE IP Configuration

GxGigeIPConfig.exe, is a matching tool of DAHENG IMAGING's MARS-Gx-P digital camera series software. Users can use this tool to implement the following functions.

1) This tool can enumerate all GigE Vision cameras attached to your network.

2) This tool can be used to change the IP address and the IP configuration.

3) This tool can also be used to change the User ID of device.

4) This tool can reset device or release the control of device.

    a) Reset：The effect is the same as powering Off-On. The program inside the device is reloaded.

    b) Reconnection：The effect is the same as closing device using SDK. After this operation, the user can connect the device again.

4.1.1. GUI

When you start up the GigE IP Configuration, you will see a GUI like the following figure.
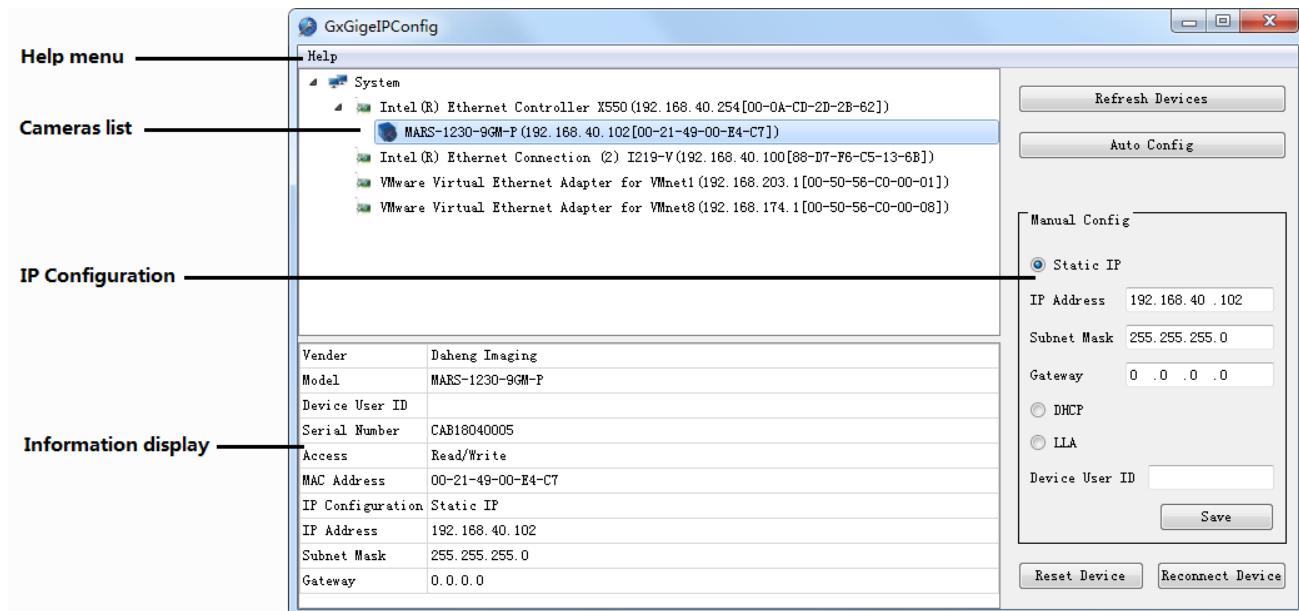
Figure 4- 1: GUI

[Help menu] Display the version and copyright of the GigE IP Configuration tool.

[Cameras list] List all GigE Vision cameras attached to your network.

[Information display] It will display the information of a selected node which can be a camera or a Network Interface Card. When the tree list root node is selected, the information display window is empty.

[Refresh Devices] Update the network adapters list and the Cameras list.

[Auto Config] Configurate the IP address of the current network card and all the devices under it.

[Static IP] If this item is selected, it will use this static IP address.

[DHCP] If this item is selected, the camera is configured to use a Dynamic Host Configuration Protocol (DHCP) server to obtain an IP address.

[LLA] If this item is selected, the camera will assign itself an Auto IP address (LLA, Link-Local Address), And the Auto IP address range 169.254.0.1to 169.254.255.254.

[Device User ID] The user-defined identity for camera settings and the content is a character string.

[Save] Click the **Save** button, the tool will save the current configuration to the selected camera which takes a few seconds.

[Reset] The effect is the same as powering Off-On. The program inside the device is reloaded.

[Reconnection] The effect is the same as closing device using SDK. After this operation, the user can connect the device again.

4.1.2. Using Guide

4.1.2.1. Refresh Devices

If you click the **Refresh Devices** Button, the tool will update the displayed network adapter and camera information. This way you can make sure that all of the displayed information is current. It will take one second to refresh devices, and during this period, all the buttons are disabled as the following figure shows.
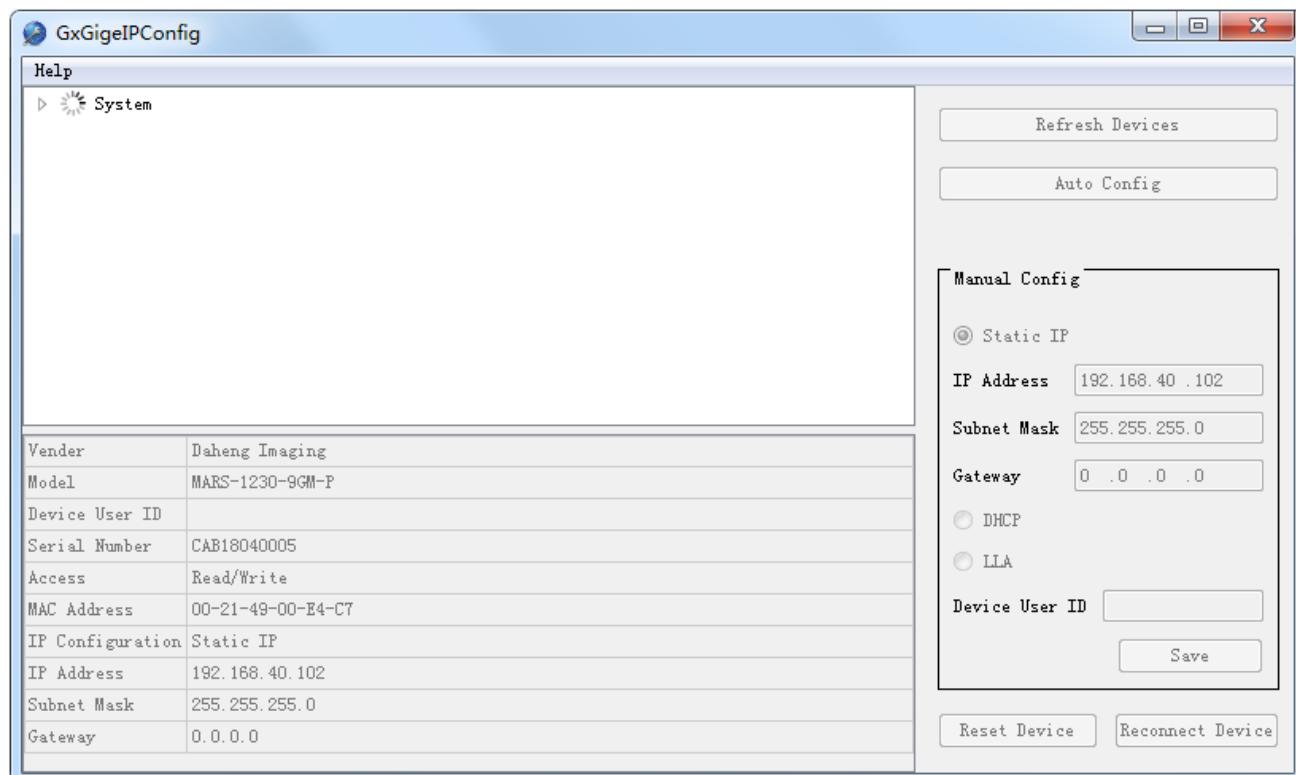

Figure 4- 2: refresh devices

4.1.2.2. Auto Config

You can configurate the device's IP address manually or automatically. In manual mode, the user is required to understand the basic network knowledge and to set the device one by one manually. In auto mode, the program will be executed automatically without the operator intervening.

If a user needs a batch of GigE cameras with no IP conflict between them, the user needs to connect all the cameras to the network and to make sure that all the cameras can be enumerated by IP configuration tools, then performs the IP config function automatically. If the user sets these cameras in two times, the IP conflict between them will be possibly caused. Please refer to note 3.

The auto config function can configure the IP address of the network card and devices which enumerated by the network card in bulk, with one push and no input needed. According to the network card's IP and device's IP, the program can configure IP automatically, under the premise of avoiding IP conflicts to the greatest extent and making minimum changes. After this function is executed, the starting mode of the GigE device is changed to static IP start mode, and the IP address is changed to permanent IP.

The auto config function has three modes:

1)   According to the network card's IP address

        If the current network card's IP is valid (Valid IP: non LLA type IP and 0.0.0.0, the same below), but the IP of devces enumerated by this network card is in the following cases: IP not in the same subnet, IP is invalid and IP conflicts with other devices, the program will modify the device's IP to the same subnet. After clicking on the button **[Auto Config]**.

2)   According to device's IP address

        If the current network card's IP is invalid, but at least one of the IP address of the devices that enumerated by the current network card is valid (Let's say the device is A), please click on the button **[Auto Config]**. According to the device's IP, the program will modify the current network card's IP to the same subnet with A, and also will modify all the devices with invalid IP under the current network card to the same subnet as device A.

3)   According to the configuration file

        If the current network card's IP and all the GigE devices' IP under the current network are invalid, the program will modify all the devices' IP under the network card and the network card's IP according to the configuration file (The configuration file is the same directory as the tool). In the configuration file, the user only needs to specify the IP address segment and subnet mask that the network card is expected to be in. The user must input the private network address of A, B, and C. Otherwise, the program will set the network card's IP address and SubNetMask as 192.168.1/24 (IP:192.168.1.0; SubNetMask：255.255.255.0).

Note：

1.   This function will modify the network card's IP when the IP of the host network card is invalid. The network card's IP which is modified may be different from the IP of user work network.

2.   The program will try its best to avoid IP conflict when modifying the IP of the device and the network card. But under the windows system, the program is difficult to discover the IP conflict between GigE

devices and other non-GigE devices on the network. In this case, the **[Auto Config]** operation may failure.

3. When the user configures the GigE cameras' IP in batches using the **[Auto Config]** function under the same environment (First, connect a batch of cameras to perform this function, then replace another batch after completion), in the two sets of cameras, the IP address may conflict.

4.1.2.3. Display Information

When you select a network adapter in the tree list, the following adapter information is displayed in the information display window below the left side of the main window.

[Display Name] The description of the network adapter.

[IP Address] The IP address of the network adapter.

[Subnet Mask] The subnet mask of the network adapter.

[Gateway] The gateway of the network adapter.

When you select a camera node in the tree list, the following camera information is displayed in the information display window below the left side of the main window.

[Vendor] The name of the camera vendor.

[Model] The name of the camera model.

[Device User ID] A user-defined identifier for the camera (if a camera has been assigned).

[Serial Number] The serial number of the camera.

[Status] The connection status of the camera.

[MAC Address] The MAC address of the camera.

[IP Configuration] The method used for assigning the current IP address to the camera.

[IP Address] The current IP address of the camera.

[Subnet Mask] The subnet mask of the camera.

[Gateway] The gateway used by the camera.

4.1.2.4. Configure IP address

You should select the camera node which is to be modified in the camera list, check the **Static IP** radio box**,** and input the **IP Address**, **Subnet Mask**, and default **Gateway**, then click **Save** button to complete the IP address setting, at the same time, setting the IP configuration mode as **Static IP**, see Figure 4- 3:
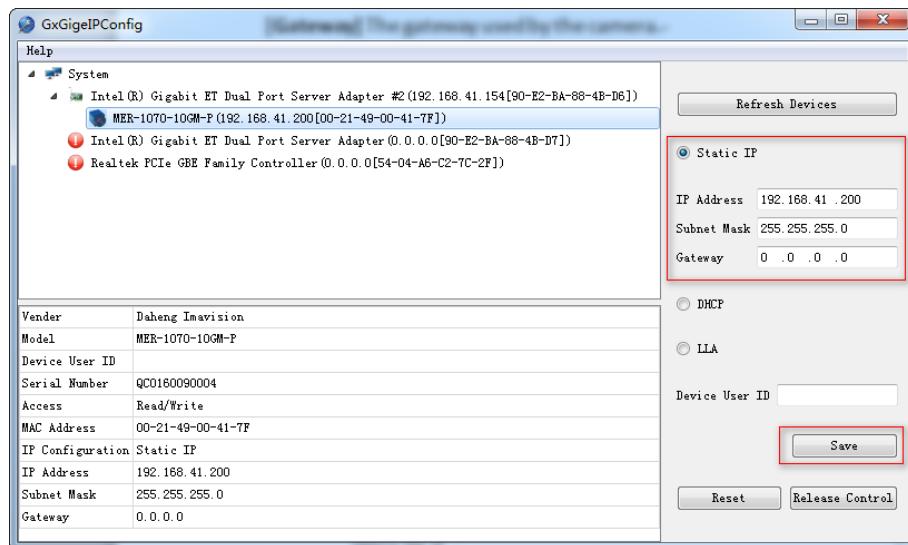
Figure 4- 3: IP Configuration Tool

4.1.2.5. IP configuration Mode

You should select the camera node which is to be modified in the camera list, select the **Static IP, DHCP,** or **LLA**, then click **Save** button, the details as follows:

● **To set a camera to a static IP address**

1) In the top pane of the tool, select the camera whose IP configuration you want to change.

2) In the right pane of the tool, select Static IP. The fields IP Address, Subnet Mask and Gateway become active. If you are choosing Static IP for the first time, the fields are empty. Otherwise, the fields will display the current values of the device.

3) Enter the desired IP address in the IP Address field.

4) Fill in the fields Subnet Mask and Gateway.

   a) If you are choosing **Static IP** for the first time, the fields **Subnet Mask** and **Gateway** will be populated automatically when you put the cursor in them.

   b) If you are changing an existing static IP address, change the current values if required.

5) Click the Save button. When the tool has finished saving, the information in the top pane and the lower left area will have been updated automatically. Once you have completed that procedure, the settings you have made here will be applied.

● **To set a camera to DHCP**

Operation steps：

1) In the top pane of the tool, select the camera whose IP configuration you want to change.

2) In the right pane of the tool, select DHCP.

3) Click the Save button. When the tool has finished saving, the information in the top pane and   the lower left area will be updated automatically.

Operation results

1) Change the camera IP configuration mode as "DHCP";

2) If operating successfully, the current IP address is the one which is allocated by the DHCP servers, if the DHCP servers is not exist, the camera's IP will be configured with LLA.

● **To set a camera to AUTO IP (LLA)**

Operation steps

1) In the top pane of the tool, select the camera whose IP configuration you want to change.

2) In the right pane of the tool, select **Auto IP (LLA)**.

3) Click the **Save** button. When the tool has finished saving, the information in the top pane and   the lower left area will have been updated automatically.

Operation results

1) Change the camera IP configuration mode as "LLA";

2) If operating successfully, the current IP address is allocated with the LLA mode;

4.1.2.6. To Change the Device User ID

1) In the top pane of the tool, select the camera whose device user ID you want to change.

2) Enter a new device user ID for the camera in the **Device User ID** field. You can only enter **ASCII** characters. The maximum length allowable is 16bytes.

3) Click the **Save** button. When the tool has finished saving, the information in the top pane and the lower left area will have been updated automatically.

4.1.2.7. Reset and Reconnection

The Button is not available if the device does not support this feature.

Reset：When the device is not convenient to power down, but also need to reload the program, this feature can be used at this time.

Reconnection：This function is generally used debugging device using Visual Studio. In debug mode, the heartbeat timeout becomes 5 minutes. If user exits process without close device, the device cannot be reset immediately and device cannot be reopened immediately. In this case, you can use this feature to release the device control; you can immediately open the device.

Carefully use these two functions. The use of these two functions during acquisition can cause acquisition stop immediately.

4.1.3. Precautions

4.1.3.1. Check IP address format

⚠️ It's not allowed to enter the following IP address in the **IP Address** field.

1) The IP of Class D: 224.0.0.0 to 239.255.255.254.

2) The IP of Class E: 240.0.0.0~255.255.255.254.

3) The first paragraph of the IP address is 127 and 255.

If you enter one of these IP addresses, A red exclamation mark will be displayed in the right of the **IP Address** field and the **Save** button will be disabled as shown in the Figure 4- 4.
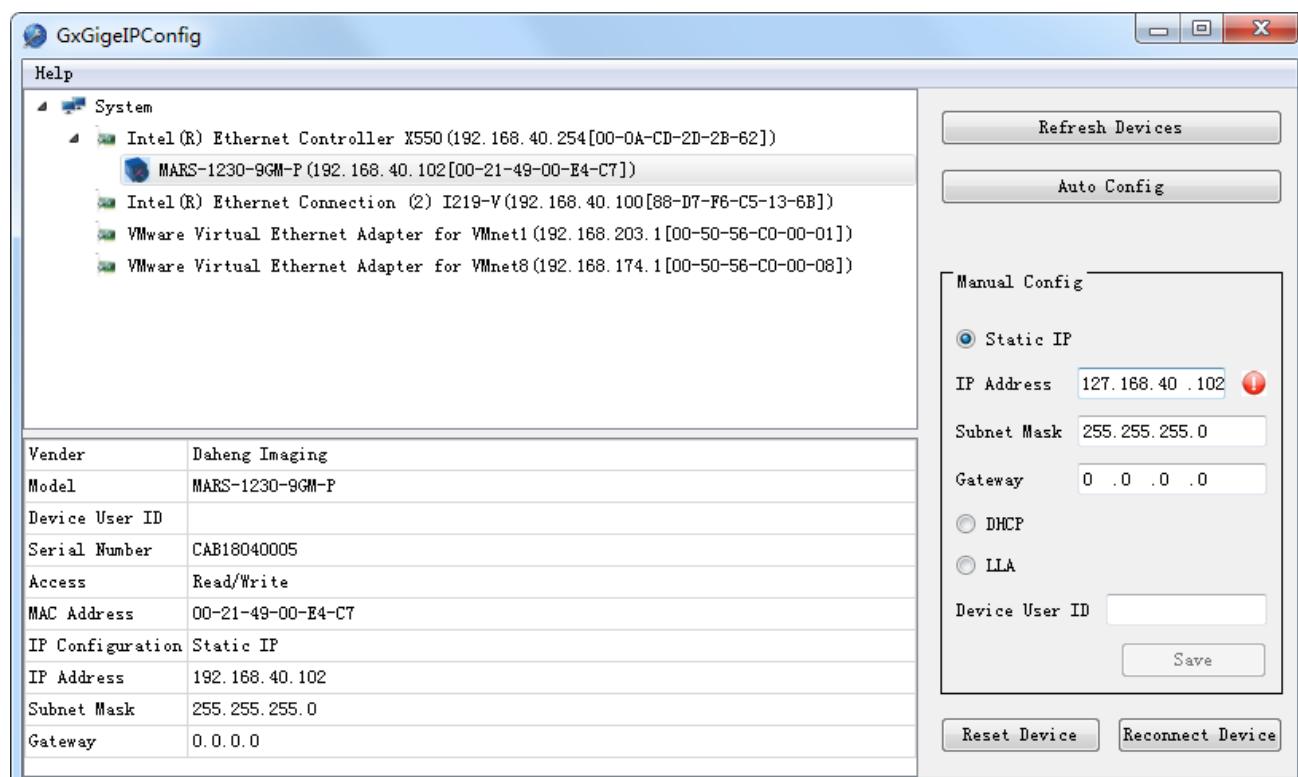

Figure 4- 4: check the IP address format

4.1.3.2. The Length Limitation of User-defined Name

The maximum length allowable of the user-defined name is 16bytes.

4.1.3.3. Tips

1) The cameras' IP address are the same

If the cameras' IP address are the same, a red exclamation mark will be displayed in the right of the Camera list, as shown in the Figure 4- 5.

2) The camera's IP address and the network card are not in the same subnet

When the camera's IP address and the network card are not in the same subnet, the camera information in the enumeration list is marked in red, as shown in the Figure 4- 5.
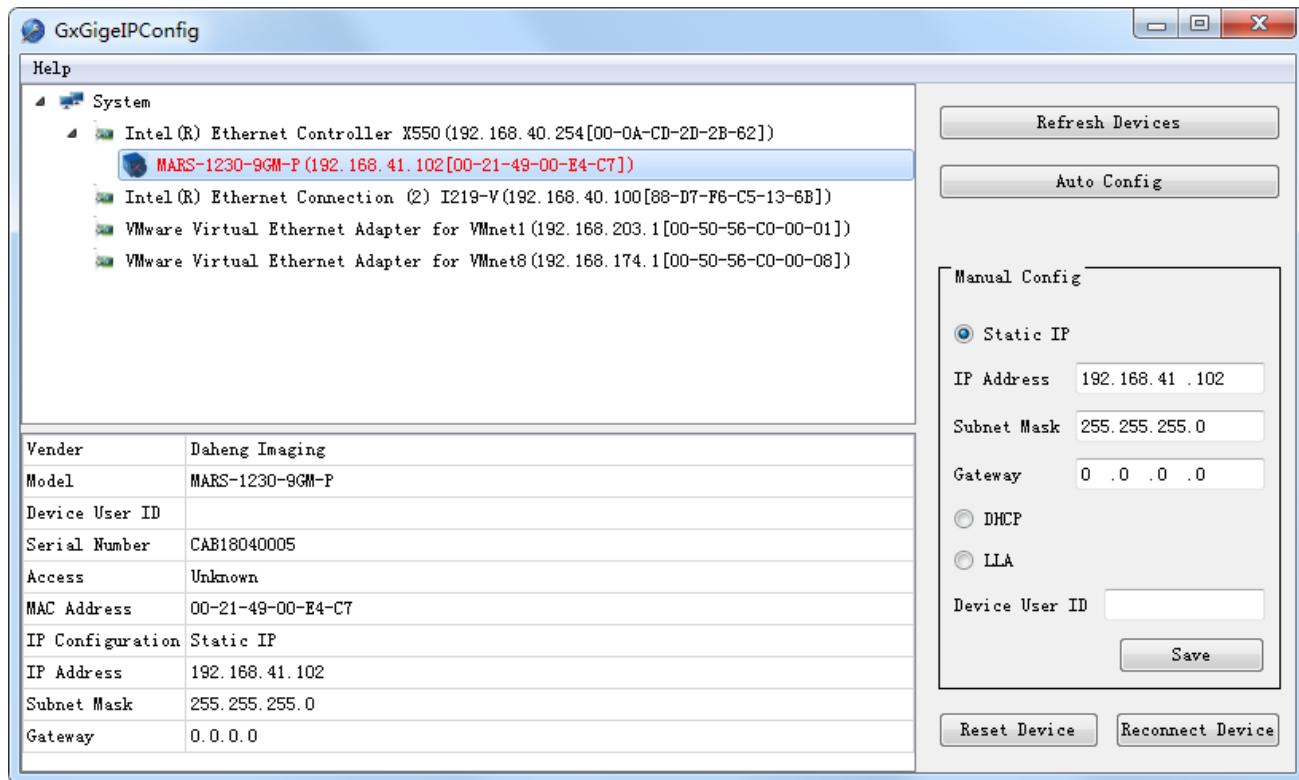

Figure 4- 5: the tips of the IP configuration tool

5. FAQ

Index	General Questions	Answers
1	The power indicator is not on when the MARS-Gx-P series camera is supplying power via PoE network card.	1) Confirm whether the power of the PoE network card is connected.
2	No images after starting acquisition.	1) Confirm the camera package length is greater than 1500; generally package length is set to be the maximum. If the host is not a huge packet mode, modify the maximum size of an IP packet to huge mode. 2) Load the default parameter group, reopen the application program, and then start acquisition again. 3) Run the demo program, and open the configuration page to confirm whether the data packet is received. If any data packets, but no good images, please check your environment settings with section 1.7.
3	The frame rate is not up to the nominal value.	1) Choose a better host. 2) Choose a recommended Intel series Gigabit Network card. 3) Contact with the technical support.
4	Lose frames seriously in a multiple cameras application.	1) Adjust the packet size or packet delay parameters, but farme rate reducing followed . 2) Using multiple network cards, and the cameras are connected separately to different network cards.
5	In the non-activated Windows7 64 on the machine, the installation of Galaxy SDK has been successfully, but open the demo program failed.	1) Activate Windows7 64, uninstall the package, restart the system, reinstall the package and open the demo program again.
6	Fail to open device, prompting the XML file parsing error.	1) Contact with the technical support to obtain upgrade program, and then upgrade your cameras.
7	Cannot receive any image after Modifying the packet delay to a larger value.	1) Confirm the data block timeout settings in the configuration page, and adjust the timeout settings until the image data is received.
8	The cameras cannot be enumerated in WindowsXP.	1) Check if the network is connected. 2) Enumerate repeatedly. 3) Modify the host IP address, and enumerate once again. Make sure that the host IP address is not the same as the camera.

9	The device fails to start acquisition, and the "Attach Buffer fails" error occurs.	1) Modify the stream layer parameter MaxNumQueueBuffer (the maximum buffer number of acquisition queue) to below 9, this solution may reduce the acquisition performance, for the user who has low requirement of acquisition frame rate or the user who use trigger mode can select this way, but it is not recommended to the user who has higher requirements of acquisition frame rate. 2) Increasing the physical memory size and replacing the 32bit system with a 64bit system, it is recommended for windows7 and above, it is a good solution to this problem.
10	Use PCI network card, the acquisition frame rate is 0.	1) Adjusting the acquisition parameters, to reduce the acquisition frame rate of the camera. 2) Change the network card to a PCI-E interface card.

6. Revision History

Index	Version	Changes	Date
1	V1.0.0	First release.	2018-06-08
2	V1.0.1	Delete FCC Description	2018-06-19
3	V1.0.2	Modify I/O interface diagram	2018-07-23