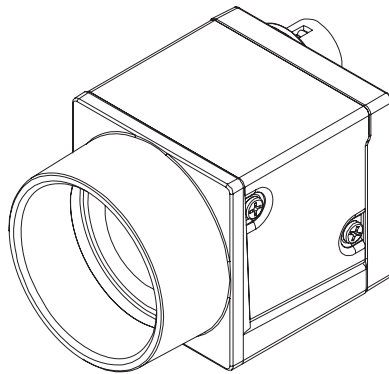


# Mars Area Scan Cameras User Manual



V2.2.0, Mar. 2022

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## Preface

## Purpose

This Manual is a basic description of Mars GigE and USB 3.0 Area Scan Cameras, which mainly includes the product description, quick installation guide and Simple introduction of SDK(iCentral).

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## Disclaimer

The information and specifications described in this manual are subject to change without notice.

## Latest Manual Version

For the latest version of this manual, see the Download Center on our web site at: <http://www.contrastech.com/en/service/005001.html>

## Technical Support

For technical support, e-mail: [support@contrastech.com](mailto:support@contrastech.com).

## Warranty

To ensure that your warranty remains in force, adhere to the following guidelines:

### **Do not remove the camera's serial number label**

If the label is removed and the serial number can't be read from the camera's registers, the warranty is void.

### **Do not open the camera housing**

Do not open the housing. Touching internal components may damage them.

### **Prevent ingress or insertion of foreign substances into the camera housing**

Prevent liquid, flammable, or metallic substances from entering the camera housing. If operated with any foreign substances inside, the camera may fail or cause a fire.

### **Avoid electromagnetic fields**

Do not operate the camera in the vicinity of strong electromagnetic fields. Avoid electrostatic charging.

### **Clean with care**

Avoid cleaning the sensor if possible.

### **Handle this camera with care**

Do not abuse the camera. Avoid striking, shaking, etc. The camera could be damaged by improper handling.

### **Read the manual**

Read the manual carefully before using the camera.

## CHAPTER 1

# PRODUCT DESCRIPTION

## Product Introduction

Mars series industrial cameras compatible with GigE、10GigE、USB3.0、Cameralink and CoaXPress data bus standards, support GenICam、USB3 Vision® and GigE Vision®, Smoothly connect with third-party software, like HALCON and Vision Pro, not need for secondary development. Mars series cameras with excellent cost performance and very suitable for various inspections measurement and high-speed imaging applications. This series cameras won customers high praise because its outstanding performance in cellphone and tablet PC screen inspection, LED automatic packaging, defect inspection, and electronic components manufacturing, wafer positioning and other applications.

With this variety of sensors and interfaces, combined with the extensive features offered, Mars series cameras are fit for a wide range of vision applications.

## Product Features

- Ethernet interface provides 1Gbps bandwidth, with maximum 100m transmission;
- USB3.0 interface supports theoretical 5Gbps bandwidth. USB interface also provides power supply;
- 128MB on-board frame buffer for image data retransmission under burst mode;
- Supports software trigger, external trigger, mixed mode, free run mode and etc.;
- Supports sharpness, noise reduction, gamma correction, LUT, black level correction, brightness, contrast and other ISP functions;
- Supports interpolation algorithm, white balance algorithm, color conversion matrix, hue, saturation and etc. for color camera;
- Supports various output formats for image data and supports ROI, binning, mirror and etc.;
- Conforms to GigE Vision V2.0 / USB3 Vision protocol and GenICam standard;
- Supports POE power supply and DC 6V~26V wide-range power supply for GigE Cameras.

## Mechanical Dimensions

The dimensions is in millimeters

- GigE Cameras with 29\*29\*42mm housing are as shown in Figure 1-1.
- GigE Cameras with 29\*29\*29mm housing are as shown in Figure 1-2.
- USB3.0 Cameras with 29\*29\*29mm housing are as shown in Figure 1-3.
- Mounting Brackets are as shown in Figure 1-4.

Camera housings are equipped with mounting holes on the bottom as shown in the drawings

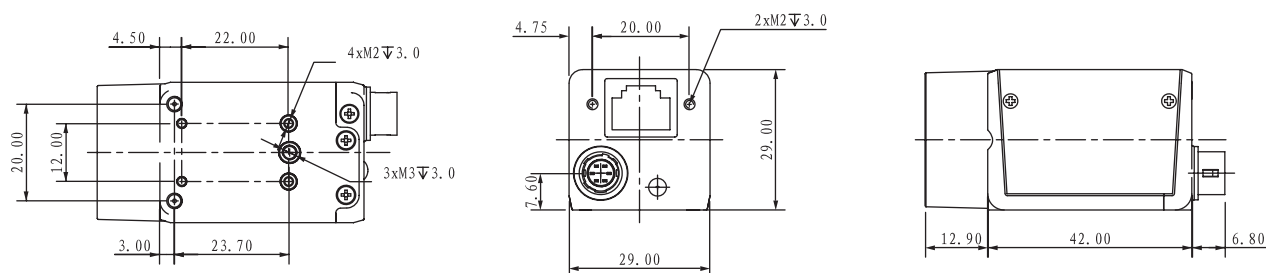


Fig. 1-1: Mechanical Dimensions (in mm) for GigE Cameras with 29\*29\*42mm housing (without GPIO).

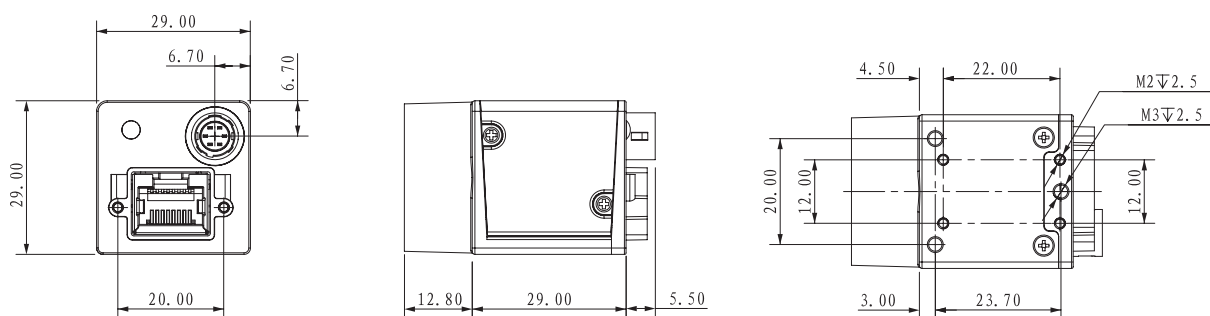


Fig. 1-2: Mechanical Dimensions (in mm) for GigE Cameras with 29\*29\*29mm housing (with GPIO).

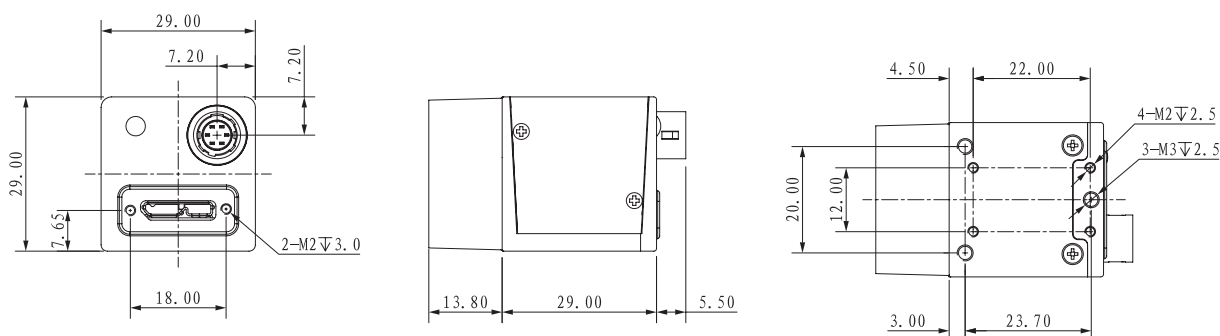


Fig. 1-3: Mechanical Dimensions (in mm) for USB 3.0 Cameras.

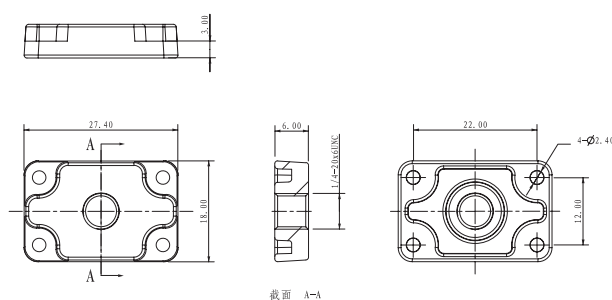


Fig. 1-4: Mechanical Dimensions (in mm) for Mounting Bracket.

## Electrical Standard

GigE Camera	Description
Data Output	Fast Ethernet(100Mbit/s)or Gigabit Ethernet(1000Mbit/s)
Synchronization	Via hardware trigger, via software trigger, or free run
Exposure Time Control	Via hardware trigger or programmable via the camera API
Camera Power Requirements	PoE (Power over Ethernet 802.3af compliant) <sup>1</sup> or <sup>2</sup> +6~+24VDC/1A, <1% ripple,via the camera's 6-pin Hirose connector, SELV and LPS compliant. Cable must be at least a 26 AWG cable. Max. cable length: 10 m
Input / output interface	1 opto-isolated input line and 1 opto-isolated output line. 1 GPIO (can be set to operate as an input or an output). <sup>3</sup>
Weight	≈ 88g
Lens Adapter	C-mount
Note: 1. Only for 29*29*42mm models; 2. PoE and 6~24VDC as a backup for each other; 3. Only for 29*29*29mm models.	

USB 3.0 Camera	Description
Data Output	USB3.0 Maximum Frame Rate 5Gbit/s (Super Speed)
Synchronization	Via hardware trigger, via software trigger, or free run
Exposure Time Control	Via hardware trigger or programmable via the camera API
Camera Power Requirements	Nominal +5 VDC; SELV and LPS compliant and in accord with the Universal Serial Bus 3.0 specification; supplied via the camera's USB 3.0 port.
Input / output interface	1 opto-isolated input line, 1 opto-isolated output line, and 2 direct-coupled GPIO lines.
Weight	≈ 66g
Lens Adapter	C-mount

## Status LED Description

Mode	Status LED	Description
Normal	Red	Fast Flashing Red
	Blue	Low-light Blue
		High-light Blue
		Fast Flashing Blue
		Slow Flashing Blue
	Red ↔ Blue	Flashing Alternately Red and Blue
Abnormal	Red	Steady Red
		Slow Flashing Red

## Avoiding EMI and ESD Problems

The cameras are frequently installed in industrial environments. These environments often include devices that generate electromagnetic interference (EMI) and they are prone to electrostatic discharge (ESD). Excessive EMI and ESD can cause problems with your camera such as false triggering or can cause the camera to suddenly stop capturing images. EMI and ESD can also have a negative impact on the quality of the image data transmitted by the camera.

To avoid problems with EMI and ESD, you should follow these general guidelines:

- Always use high quality shielded cables. The use of high quality cables is one of the best defenses against EMI and ESD.
- Try to use camera cables that are only as long as necessary and try to run the camera cables and power cables parallel to each other. Avoid coiling camera cables. If the cables are too long, use a meandering path rather than coiling the cables.
- Avoid placing camera cables parallel to wires carrying high-current, switching voltages such as wires supplying stepper motors or electrical devices that employ switching technology. Placing camera cables near to these types of devices can cause problems with the camera.
- Attempt to connect all grounds to a single point, e.g., use a single power outlet for the entire system and connect all grounds to the single outlet. This will help to avoid large ground loops. (Large ground loops can be a primary cause of EMI problems.)
- Use a line filter on the main power supply.
- Install the camera and camera cables as far as possible from devices generating sparks. If necessary, use additional shielding.
- Decrease the risk of electrostatic discharge by taking the following measures:
  - Use conductive materials at the point of installation (e.g., floor, workplace).
  - Control the humidity in your environment. Low humidity can cause ESD problems.

## Precautions

### NOTICE

#### Cleaning of the sensor and the housing

##### Sensor

Avoid cleaning the surface of the camera's sensor if possible. If you must clean it:

- Before starting, disconnect the camera from camera power and I/O power.
- Use a soft, lint-free cloth dampened with a small amount of high-quality window cleaner.
- Because electrostatic discharge can damage the sensor, you must use a cloth that won't generate static during cleaning (cotton is a good choice).
- Make sure the window cleaner has evaporated after cleaning, before reconnecting the camera to power.

##### Housing

To clean the surface of the camera housing:

- Do not use solvents or thinners; they can damage the surface.
- Use a soft, dry cloth that won't generate static during cleaning (cotton is a good choice).
- To remove tough stains, use a soft cloth dampened with a small amount of neutral detergent; then wipe dry.

## CHAPTER 2

# POWER AND I/O INTERFACE DEFINITION

## I/O Connection Definition and Assignments

The camera rear appearance contains standard RJ45/USB3.0 interface, 6pin power and I/O input connector and camera working status indicator light. Read the followings to get pin definitions. Refer to the pin definitions and labels attached to the power and I/O cable to wire the device.

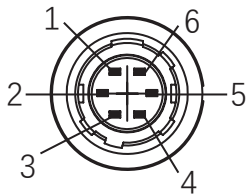


Table 2-1:  
Numbering and assignments for  
6pin Power and I/O Input Connector:

Color	Pin	Signal	Description
Red	1	-	+6~24VDC Camera Power <sup>2</sup>
Green	2	Line1	Opto-coupler Isolated Input
White	3	Line2	GPIO(Non-isolated software configurable input and output I/O) <sup>1</sup>
Blue	4	Line0	Opto-coupler Isolated Output
Brown	5	GND	Opto-coupler Isolation Signal Ground (ISO_GND)
Black	6	-	DC Camera Power Ground and GPIO Signal Ground (GND)

1. Only 29\*29\*29mm GIGE cameras have this function.

2. Pin1 is used as the camera's auxiliary power supply input. When the output power of the USB port of the PC is insufficient or the USB cable is long, please use this pin to provide power to the camera to ensure reliable operation of the camera.

### I/O Cable

Recommendations for the I/O cable.:

- The I/O cable must be shielded.
- You should use a twisted pair wire.
- Maximum recommended cable length: 10 m
- Pin assignment (see Table 2-1)
- Close proximity to strong magnetic fields should be avoided.

Depending on the particular application, using different cables may lead to voltage drops, signal distortion, and EMI/ESD problems which in turn may cause the camera to malfunction.



Note that direct-coupled GPIO lines have the advantage of working with very short delays compared to opto-isolated I/O lines.

Note also that the direct-coupled GPIOs are distinctly more susceptible to EMI than the opto-isolated I/Os. Under harsh EMI conditions, GPIOs can turn out not to be usable at all.

Accordingly, use of the GPIOs in an environment with elevated risk of EMI calls for taking additional measures like, e.g. using shorter cables.

## NOTICE

### An incorrect plug can damage the I/O connector.

The plug on the cable that you attach to the camera's I/O connector must have 6 female pins. Using a plug designed for a smaller or a larger number of pins can damage the connector.

The wire color of this user manual is the color of ContrasTech. If you use other manufacturers' cable color definitions may be different, random connection may cause the camera to burn out, please connect according to the I/O port type and pin definition or contact our technical staff for advise.



ContrasTech offers suitable plugs and cables.

Contact your sales representative to order connectors or cables.

## CHAPTER 3

# INSTALLATION AND SETUP

You should perform the software installation procedure first and the hardware installation procedure second.

## Software Installation

### ■ iCentral Installation

If you use a firewall on your computer, disable the firewall for the network adapter to which your camera is connected.

#### Close the Firewall

In order to ensure the camera software keep running and image transmission stability, please close the firewall before using the software.

#### System Requirements

Mars Camera Software Suite for Windows requirements that one of the following operating systems is installed on your computer:

- Windows 7 (32 bit or 64 bit)
- Windows 10 (32 bit or 64 bit)

#### Brief Introduction of Mars Camera Software Suite

The options available with the Mars Camera Software Suite let you change parameters and control the camera by using a stand-alone GUI (known as iCentral) or by accessing the camera from within your software application using the API.

The Mars Camera Software Suite is designed for use with all Mars cameras with both the GigE and USB 3.0. The iCentral offers reliable, real-time image data transport into the memory of your computer at a very low CPU load.

The Mars Camera Software Suite includes several tools that you can use to change the parameters on your camera, including iCentral and API for different programming languages (C#/C++/.NET).

#### Installation Steps

- 1.You can download the iCentral software (Mars Series Industrial Cameras SDK For xxx) from:  
<http://www.contrastech.com/en/service/005001.html>
- 2.Double click iCentral installation package to install the client.
- 3.Follow the instructions on the screen. The installer will guide you through the installation process.



## Hardware Installation

### ■ Installing a GigE Camera



If you use a firewall on your computer, disable the firewall for the network adapter to which your camera is connected.

The installation procedures assume that you will be making a peer-to-peer connection between your camera and a computer. Make sure that the following items are available before starting the installation:

- A Mars GigE camera;
- As applicable, a power supply or a GigE power injector;
- As applicable, a C-mount or a CS-mount lens for the camera;
- A computer with a GigE network adapter installed; (The computer must be equipped with an appropriate operating system.)
- A standard Ethernet patch cable(CAT 5E or better).

You should perform the software installation procedure first and the hardware installation procedure second.

#### Steps:

1. Mount a C-mount lens or CS-mount lens with adapter onto your camera. For C-mount and CS-mount lenses, make sure that the lens is screwed into the camera's lens adapter as far as it will go;
2. Connect the camera to the computer and power.

#### **If you are using PoE:**

- a. Connect one end of a network cable to the network connector of the power injector labeled "Data In" and connect the other end of the cable to the network connector of the GigE network adapter in your computer;
- b. Connect one end of the AC cable for the power injector to the injector's body and the other end to an AC outlet;
- c. Connect one end of a network cable to the network connector of the power injector labeled "PoE Out" and connect the other end of the cable to the network connector of the camera.

#### **If you are using 6-Pin Hirose cable:**

- a. Plug one end of an Ethernet cable into the network adapter in your computer and the other end of the cable into the GigE connector of the camera;
- b. Plug the 6-pin connector of the cable from your power supply into the 6-pin connector of the camera.
- c. Switch on the power supply

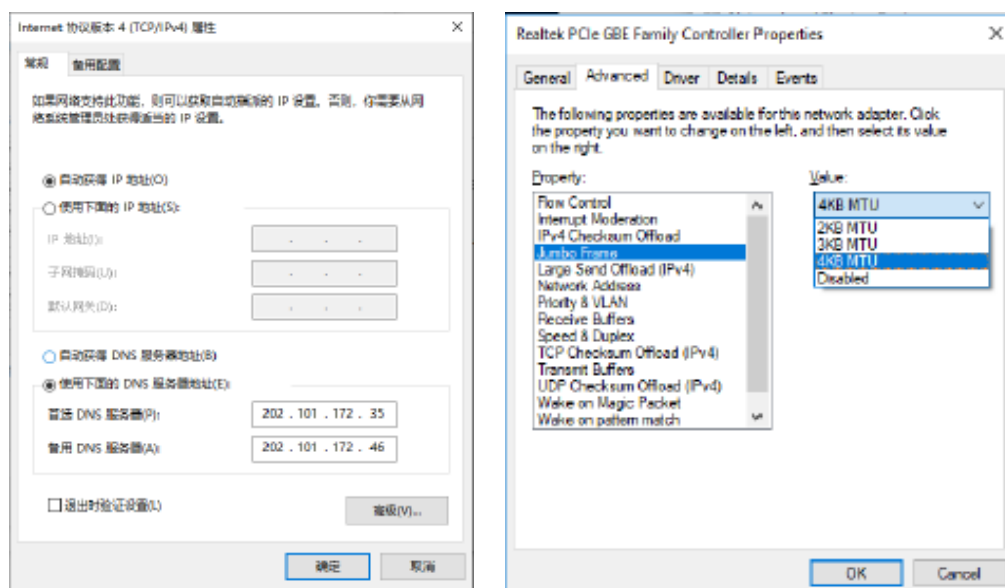
## Hardware Installation

### Network Settings

Before using the camera, you need to configure IP is in the same network segment with the computer. You can modify it in "Local Connection" to ensure network communication is normal.

Local Network Configuration :

- Click "Control Panel"> "Network and Internet"> "Network and Sharing Center"> "Change Adapter Configuration." Then select corresponding network card to configure it automatically obtain IP address or manually assign it as same network segment address with the camera. Shown as below:
- Open "Advanced" in the properties, set "Jumbo Frame" as its maximum value:9014bytes, both of transmit buffer and receive buffer set as 2048bytes, the Interrupt Throttle Rate set as extremum value. These maximum values mentioned above depend on the specific network card. Shown as below:



### ■ Installing a USB 3.0 Camera

The installation procedures assume that you will be making a peer-to-peer connection between your camera and a computer. Make sure that the following items are available before starting the installation:

- A Mars USB 3.0 Area Scan camera;
- As applicable, a C-mount or CS-mount lens for the camera;
- A computer with a USB port;
- A USB cable. Contact our sales representative for ordering a suitable cable assembly.

You should perform the software installation procedure first and the hardware installation procedure second.

#### Steps:

1. Remove the protective cap from the lens mount;
2. Mount a lens on the camera;
3. Mount the camera in your test setup;
4. If you want to use any of the camera's I/O lines, carry out the following steps:
  - a. Connect one end of the I/O cable to the I/O connector of the camera;
  - b. Connect the other end of the I/O cable to the device intended for sending and receiving I/O signals.
5. Connect the USB cable:
  - a. Connect one end of the USB cable to the USB Micro-B receptacle on the camera.
  - b. Connect the other end of the USB cable to a USB port of your computer.

We strongly recommends connecting the camera to a USB 3.0 port. When connected to a USB 2.0 port, functionality and data transmission rate of the camera will be limited.

The camera will power up. Windows will find the suitable camera driver in the Mars Camera Software Suite.

You can also use iCentral to check whether your camera was detected; acquire images, display images, and adjust parameter settings to improve image quality.

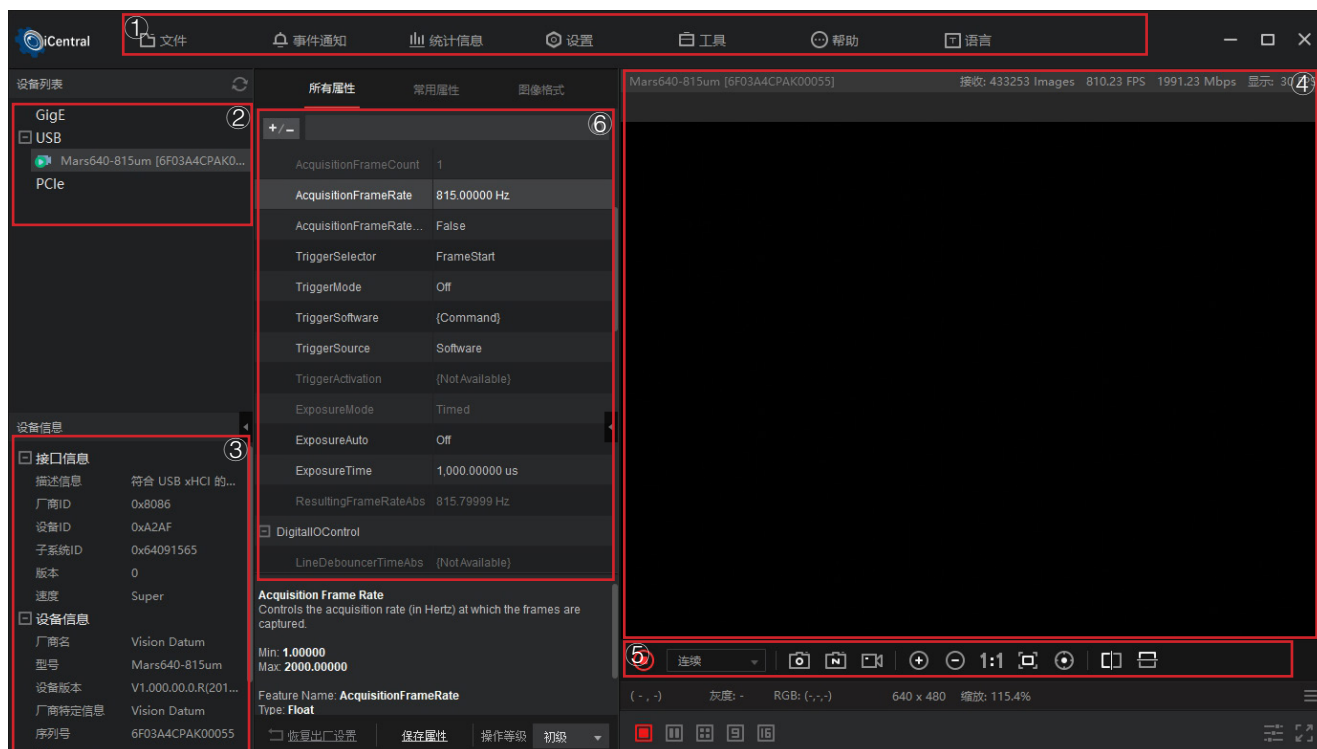
## Software Operation

### iCentral Operation

1、Double-click the iCentral shortcut on the desktop to open up the client software.

#### Main interface

For specific main window of the client software, please refer to the actual one you got.



No.	Parameter	Description
①	Menu Bar	See the table below for details.
②	Device List	<p>Including four types: GigE, USB and CameraLink, PCIe. Click the refresh icon to manually refresh the online device information.</p> <p> Indicates that the device can be connected.</p> <p> Indicates that the device is already connected. The iCentral can connect with or operate one camera once.</p>
③	Device Information	Includes the interface info that the device is connected and the camera info.
④	Display	Includes stream, frame rate, bandwidth, display frame rate, errors, image resolution and so on.
⑤	Tool bar	<p> Play/Stop. There are three mode of acquiring images: Continous, Single frame, multiple frames.</p> <p> Save single/multi-frame pictures.</p> <p> Zoom in/Zoom out the displayed image.</p> <p> 1:1/Display the image according to the display panel size/Image centered (The image is centered back to the center when it is dragged).</p> <p> Vertical or Horizontal mirror image.</p>
⑥	Property panel	Expand or merge all merged or expanded attributes.

## Software Operation

2、Click ">" in the camera's feature panel to unfold the specific camera parameters, and set them according to actual demands. Please see the table below for the introduction of each attribute classification.

Attribute	Description
<i>DeviceControl</i>	You can view the device information, edit its name, reset the device, etc.
<i>ImageFormatControl</i>	You can view and set the device's resolution, image reverse function, pixel format, region of interest, test pattern, etc.
<i>AcquisitionControl</i>	You can view and set the device's acquisition mode, frame rate, trigger mode, exposure time, etc.
<i>DigitalIOControl</i>	You can set the different input and output signals.
<i>EventControl</i>	You can view and set the type of event message.
<i>AnalogControl</i>	You can view and set the device's gain, black level, Gamma correction, sharpness, etc.
<i>LUTControl</i>	You can view the Look-Up Table (LUT), and set its index and value.
<i>TransportLayerControl</i>	You can view and set the parameters of the device's transport layer.
<i>UserSetControl</i>	You can view and set the camera's save and load User Set, and you can also set the User Set that is started by default.
<i>ColorTransformation Control</i>	You can view and set the device's color transformation related parameters like hue and saturation.
<i>CounterAndTimerControl</i>	You can view and set the counter related parameters.
<i>ISPControl</i>	You can view and set the sharpness, brightness, saturation, contrast, etc.



The camera's attribute tree and parameters may differ by camera models.

### ■ Menu Bar

The menu bar for iCentral client provides following functions: File, View, Settings, Tool and Help, as shown in the figure below.

Menu		Description
<i>File</i>	Open	Opens a new *.mvcfg format file. Select "File> Open File" and select a file in the pop-in, click "Open."
	Open Recent	Select "File> Open Recent File", the software displays the 10 files that the user has recently used in iCentral. Click the name of a file to open it directly.
	Save	Save the changes to the current file.
	Save as	Save the current file to another location.
<i>Event</i>	Event Monitor	Including GenIcam paramters updates, messaging channel events and PvStream buffers.
<i>Statistics</i>	<i>Statistics</i>	Count the acquisition(FPS), bandwidth, received images, lost blocks, and error images.
<i>Settings</i>	General Setttings	Visibility: Beginner, Expert, Guru. Each state can see different parameters in the property panels.、 Refresh device list、 Restore default parameters
	Image Save	Save the video stream data as a picture file.
	Record Video	Save the video stream data as a video file.
	Buffer Options	Set the number of buffers for video stream data.
	Communication Control	Set the number of packets lost during the timeout of the video stream.
<i>Tools</i>	CamTools	Firmware upgrade, SPC correction, FPN/FFC correction.
	Driver Tool	Check the installation status of GigE Vision, USB3 Vision, DirectShow, and provide quick installation
	NIC Tool	Network port camera network settings.
<i>Help</i>	About	Shows the current version No. of iCentral.
<i>Lang</i>	Chinese/English	switch Chinese/English

## CHAPTER 4

## IMAGE ACQUISITION

## Frame Rate

Frame rate refers to the image number that is acquired by the camera per second. The higher frame rate, and shorter time used for image acquisition will be.

### ■ Influential Facts for Frame Rate

- **Frame readout time:** The frame readout time is related with camera's sensor performance and image height. The lower the image height and less the frame readout time, and the higher the frame rate will be.
- **Exposure time:** If the reciprocal of max frame rate that the camera supports is  $t$ , and when the configured exposure time is larger than  $t$ , the less the exposure time, the higher the frame rate will be. When the configured exposure time is less than or equal to  $t$ , exposure time will not influence the frame rate.
- **Bandwidth:** The larger the bandwidth, the higher the frame rate will be.
- **Pixel format:** The more bytes pixel format occupy, the lower the frame rate will be.



For different models of camera, the Image compression mode may be different, please refer to the actual one you got.

### ■ Configuring Frame Rate

The camera can also manually control the real-time frame rate.

The specific steps are as follows:

Click AcquisitionControl > AcquisitionFrameRate, enter Acquisition Frame Rate according to actual demands, and enable AcquisitionFrameRateControlEnable.

AcquisitionFrameRate	1.00000 Hz
AcquisitionFrameRateEnable	True
	False
	True

- AcquisitionFrameRate means frame capture rate.
- ResultingFrameRateAbs means allow the maximum acquisition frame rate.

\_If the AcquisitionFrameRate is smaller than ResultingFrameRateAbs, the camera acquires images according to the AcquisitionFrameRate.

\_If the AcquisitionFrameRate is larger than ResultingFrameRateAbs, the camera acquires images according to the ResultingFrameRateAbs.

## Acquisition Mode

The camera has 3 types of Acquisition Mode, including SingleFrame mode MultiFrame mode and Continuous mode.

Their principle and parameter setting are shown below.

Internal trigger mode	Parameter	Parameter Value	Principle
SingleFrame mode	Acquisition Control > Acquisition Mode	SingleFrame	When camera starts image acquisition, it acquires one image only, and then stops.
Continuous mode		Continuous	When camera starts image acquisition, it acquires images continuously. Real-time frame rate decides the acquisition frame number per second. You can stop camera image acquisition manually.
MultiFrame		MultiFrame	The number of acquisitions needs to be set in AcquisitionFrameCount (1-255). After the camera starts to capture, you can continuously capture images. The user can manually stop the collection before reaching the set number of times.

When using multi-frame acquisition, the AcquisitionFrameCount option needs to be set additionally. The user selects and enters the appropriate quantity according to the usage requirements.

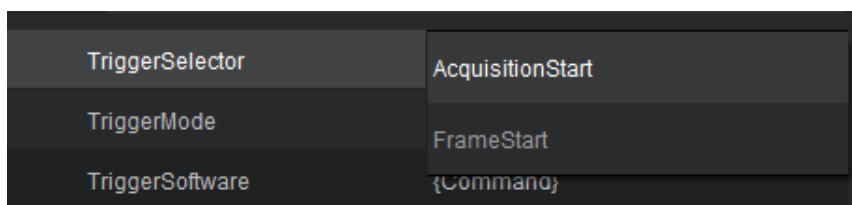
## Trigger Mode

The external trigger signals types of trigger camera acquisition can be given by software or external device. The trigger mode is divided into SoftwareTrigger (Software trigger) and lineN (Hard trigger).

### ■ Trigger Type

Select FrameStart or AcquisitionStart in TriggerSelector.

- FrameStart: Single frame acquisition, one trigger signal corresponds to one frame.
- AcquisitionStart: continuous acquisition, one trigger can trigger continuous acquisition.



### ■ External Trigger Source

External trigger mode	Parameter	Parameter Value	Principle
Software Trigger	Acquisition Control > Trigger Source	Software	The software sends trigger signal to the camera via GigE interface to acquire images.
Hardware Trigger		LineN	External device connects camera via camera I/O interface. External device sends trigger signal to camera to acquire images.

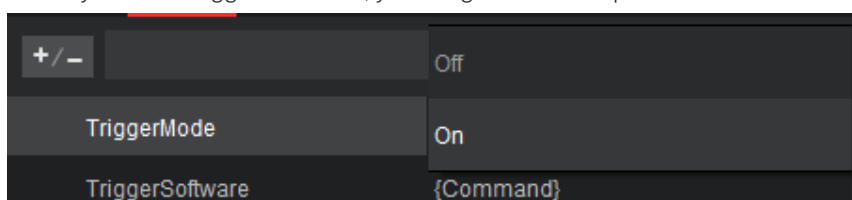


These 2 external trigger sources are valid only when the Trigger Mode is On

### ■ Software Trigger

For the camera support software trigger mode, when user set software trigger, the client software can send commands to camera to acquires and transfer images via Gigabit Ethernet.

1. Click Acquisition Control > Trigger Mode, and select On as Trigger Mode.
2. Select Software as Trigger Source, and click Trigger Software after the TriggerSoftware button to send a soft trigger command to collect images. Each time you click "Trigger Software", you will get a frame of pictures. As shown in the figure below.



## Trigger Mode

### ■ Hardware Trigger

If set "Hardware" as "Trigger Source" can switched to hardware external trigger mode.

When the camera trigger source is selected as hardware trigger, that is, when the TriggerSource parameter is selected as LineN, the command to trigger the camera is given to the camera by the external device.

The setting of trigger source is as shown below:

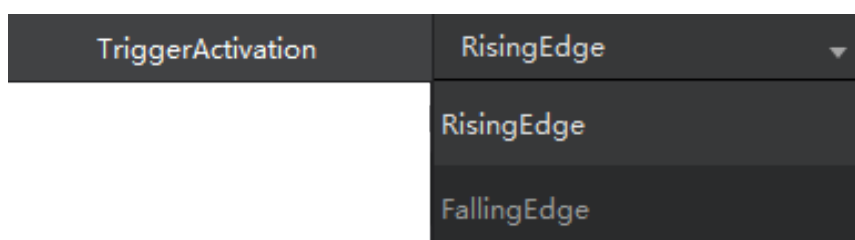
1. Click Acquisition Control, select On as Trigger Mode, select LineN as Trigger Source.

2. When the hard trigger (LineN) is turned on. You can choose to select the trigger signal through the TriggerActivation option.

● RisingEdge: Press the trigger board to trigger.

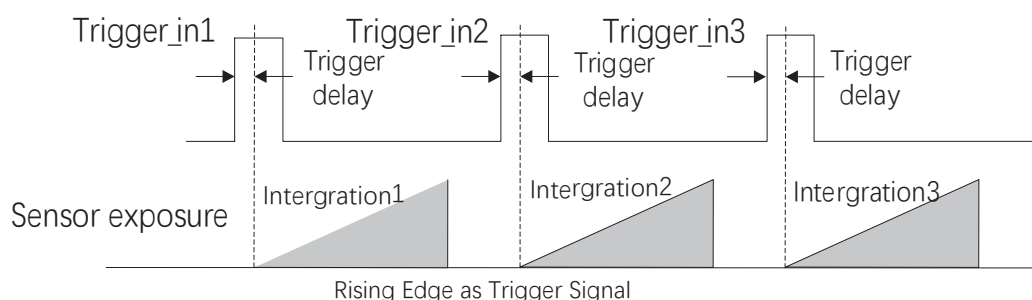
● FallingEdge: Trigger when the trigger board is released.

3. After selecting the source of the trigger signal, the user can select the appropriate trigger timing according to the actual situation.



### ■ Trigger Delay

From camera receiving signal and responding, this period is trigger delay. Its sequence diagram is shown below.



You can set proper value in Trigger Delay, the unit is  $\mu\text{s}$ .

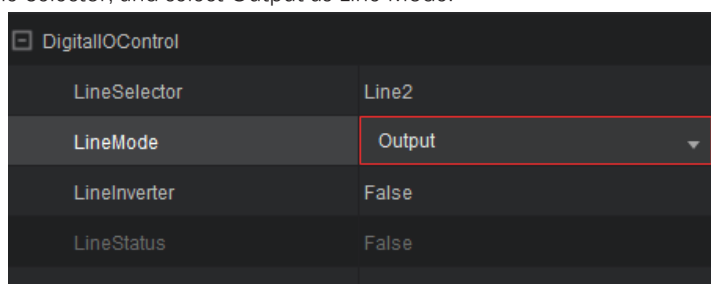
## CHAPTER 5 I/O OUTPUT

### Select Output Signal

The camera has 3 opto-isolated input , and 3 opto-isolated output.

Here we take Line 2 as an example.

1. Click Digital IO Control, select Line 2 as Line Selector, and select Output as Line Mode.



For details about the electrical characteristics and wiring of the IO interface, please refer to Chapter I/O Electrical Characteristics and Wiring.

### Set Output Signal

The output signal of the camera is switch signal that can be used to control external devices such as light source, PLC, etc.

The trigger output signal can be realized in two ways: level inversion and output signal. Set the relevant parameters through the DigitalIOControl properties.

#### ■ Enable Level Inverter

The line inverter function allows the camera to invert the electrical signal level of an I/O line, and meets requirements of different devices for high or low electrical signal level. All high signals are converted to low signals and vice versa.

Click DigitalIOControl > LineSelector, select line for Line Selector.

The Line Inverter parameter is disabled by default.

#### ■ Output Signal

The strobe signal is used to directly output I/O signal to external devices when camera's event source occurs.

The event source of the Output signal is set by the LineSource parameter. When an event source occurs, an event message will be generated, and the camera will simultaneously output an Output signal.



## CHAPTER 6

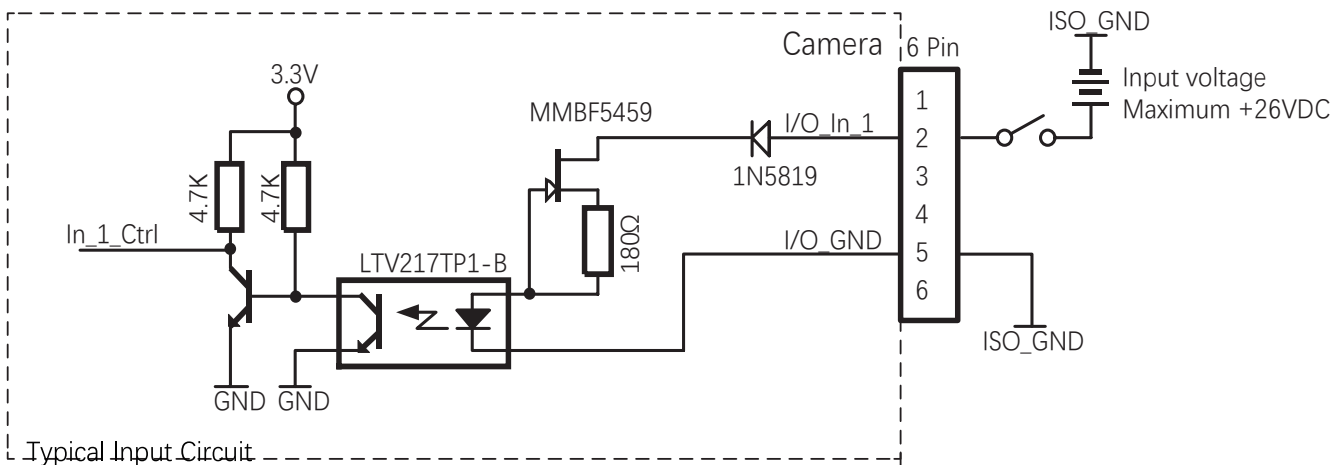
I/O ELECTRICAL FEATURE  
AND WIRING

## I/O Electrical Feature

## ■ Line1 Opto-isolated Input Circuit

Since the optocoupler is one-way transmission, it can realize the one-way signal transmission, so that the input terminal and the output terminal are completely electrically isolated, the output signal has no effect on the input terminal, and the anti-interference ability is strong and the work is stable.

The Line1 opto-isolated input circuit in camera I/O control is shown below.



Input Electrical Feature:

Input	Description
+30.0VDC	Limit voltage. Input Voltage should not exceed this limit, otherwise it will cause damage to the device.
+0~+24VDC	Safety I/O input voltage range
+0~+1.4VDC	Logic 0
>+1.4V~+2.2VDC	The input state flips here, and the logic state is indefinite within this voltage range
>+2.2VDC	Logic 1

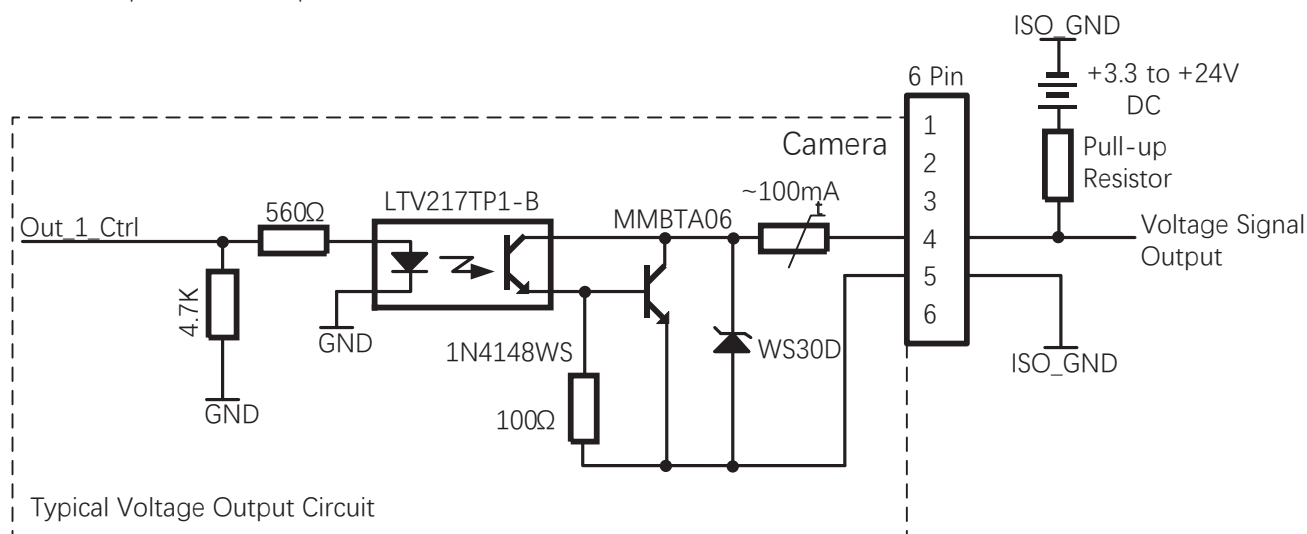


- Make sure the input voltage is not from 1 VDC to 1.5 VDC as the electric status between these two values are not stable.
- The breakdown voltage is 30 VDC, and keep voltage stable.
- The sink current of I/O input is 5mA~15mA.

## I/O Electrical Feature

### Line0 Opto-isolated Output Circuit

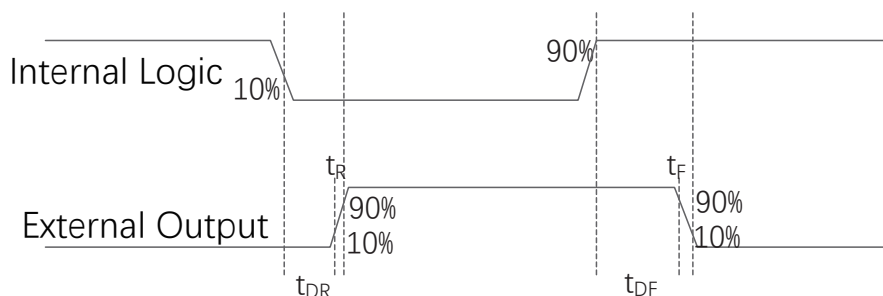
The Line0 opto-isolated output circuit in camera I/O control is shown below.



The pull-up resistor value selection in the figure should be based on the given voltage that does not exceed the maximum allowable current value of the optocoupler isolation output port. The larger the pull-up resistor value, the smaller the optocoupler conduction voltage drop, the longer the rise and fall time of the output waveform and the smaller the external driving ability.

The recommended value of optocoupler is 270Ω when 5V power supply, 560Ω when 12V power supply, and 1kΩ when 24V power supply.

Using a 1kΩ pull-up resistor, the output rise/fall time and rise/fall edge delay time under different external power supply voltages are as follows:



When the external voltage is 3.3V and the external resistance is 1KΩ, the electrical characteristics of the opto-isolated output are shown below.

External power supply voltage (V)	Rise time ( $t_R$ )	Fall time ( $t_F$ )	Rising edge trigger delay $t_{DR}$ ( $\mu$ s)	Falling edge trigger delay $t_{DF}$ ( $\mu$ s)
5	19.70	3.20	39.9	8.06
12	24.06	5.22	44.8	11.8
24	30.11	8.10	44.8	53.2

- Optocoupler output delay refers to the delay from FPGA internal logic output to external optocoupler isolation output pins.
- Rising edge trigger delay refers to the delay measured from 10% of the FPGA pin output level to 90% of the external output signal amplitude.
- Falling edge trigger delay refers to the delay measured from 90% of the FPGA pin output level to 10% of the external output signal amplitude.
- Rise time refers to the time delay measured from 10% to 90% of the external output signal amplitude.
- Fall time refers to the time delay measured from 90% to 10% of the external output signal amplitude.
- The above values are typical values measured at an ambient temperature of 25° C.



The optocoupler isolation output port allows a maximum continuous current of 50 mA. Exceeding the output current limit will cause damage to the output interface.

## I/O Electrical Feature

### ■ Direct-coupled General Purpose I/O (GPIO)

Mars 29\*29\*29mm GigE cameras have one direct-coupled GPIO line that is accessed via pin 3 of the 6-pin connector on the back of the camera. The GPIO line is designated as Line 2.

Mars USB 3.0 cameras have two direct-coupled GPIO lines that are accessed via pins 1 and 3 of the 6-pin connector on the back of the camera. The GPIO lines are designated as Line 3 and Line 2.

The GPIO lines can be set to operate as inputs to the camera or to operate as camera outputs.

The direct-coupled GPIO lines are compatible with TTL signals.

Set a GPIO line

You can set a GPIO line for input or output by using iCentral or API.

1. Set the LineSelector parameter to select the GPIO line that you want to configure.
2. Set the LineMode parameter as desired to Input or Output.

Note:

Applying incorrect electrical signals to the camera's GPIO line can severely damage the camera.

1. Before you connect any external circuitry to a GPIO line, we strongly recommend that you set a GPIO line to operate as an input or as an output (according to your needs).
2. Once a line is properly set, make sure that you only apply electrical signals to the line that are appropriate for the line's current setting.



Direct-coupled GPIO lines have the advantage of working with very short delays compared to opto-isolated I/O lines.

The direct-coupled GPIO lines are, however, distinctly more susceptible to electromagnetic interference. We therefore strongly recommend to only use the direct-coupled GPIO lines when significant electromagnetic interference will not occur.

The following parts describe the differences in the GPIO electrical functionality when the lines are set to operate as inputs and when they are set to operate as outputs.

### ■ Operation as an Input

The following I/O supply voltage requirements apply to a direct-coupled GPIO line when the line is set as an input.

Input Voltage	Significance
+26.0VDC	Absolute maximum. The absolute maximum must never be exceeded. Otherwise, the camera can be damaged.
+0~+5.0VDC	Safe operating input voltage range (the minimum external pull up voltage is 3.3 VDC).
+0~+0.8VDC	Voltage indicates a logical 0.
>+0.8~+2.0VDC	Region where the transition threshold occurs; the logical state is not defined in this region.
>2.0VDC	The voltage indicates a logical 1.

Your application must be able to accept 2 mA (sink current) from the direct-coupled GPIO input line without exceeding +0.8 VDC, the upper limit of the low status. The current draw for high-level input current is < 100  $\mu$ A.

## I/O Electrical Feature

The below figure shows the applicable electrical circuit when a GPIO line is set to operate as an input. The figure is drawn to specifically apply to pin 3 (Line 2) as an example. However, for USB 3.0 cameras, the figure applies equally to pin 1 (Line 3) with the necessary modifications.

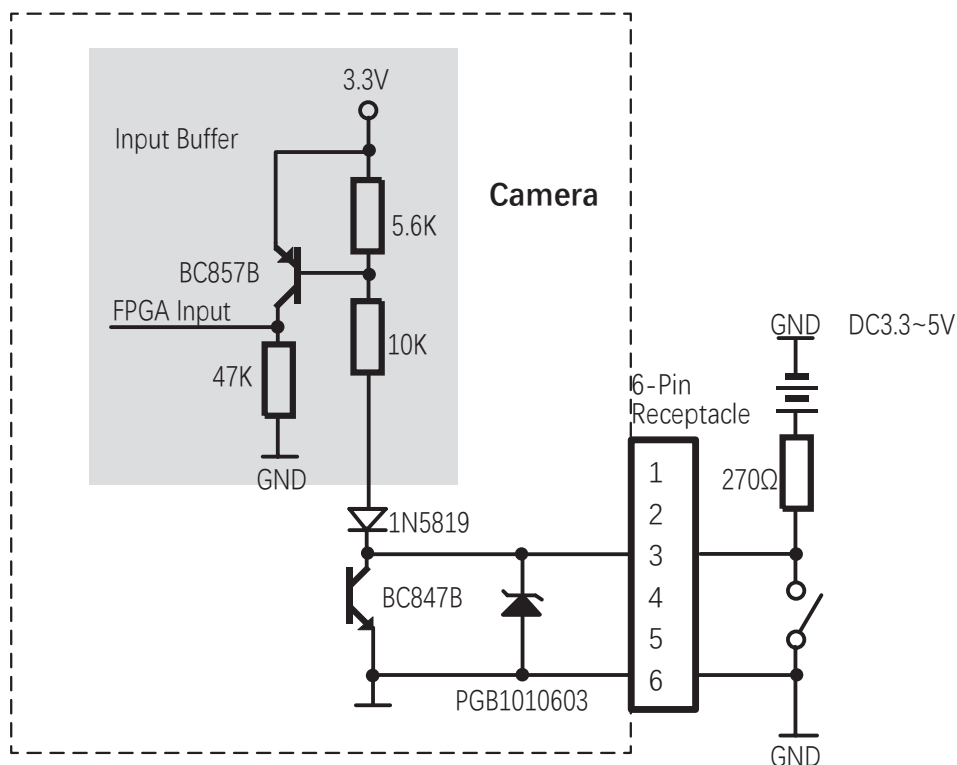


Fig. : Direct-coupled GPIO Line Schematic with the GPIO Line Set as an Input (Illustration for Pin 3 as an Example)

The below figure shows, as an example, the use of a 5V TTL logic gate in the external circuit.

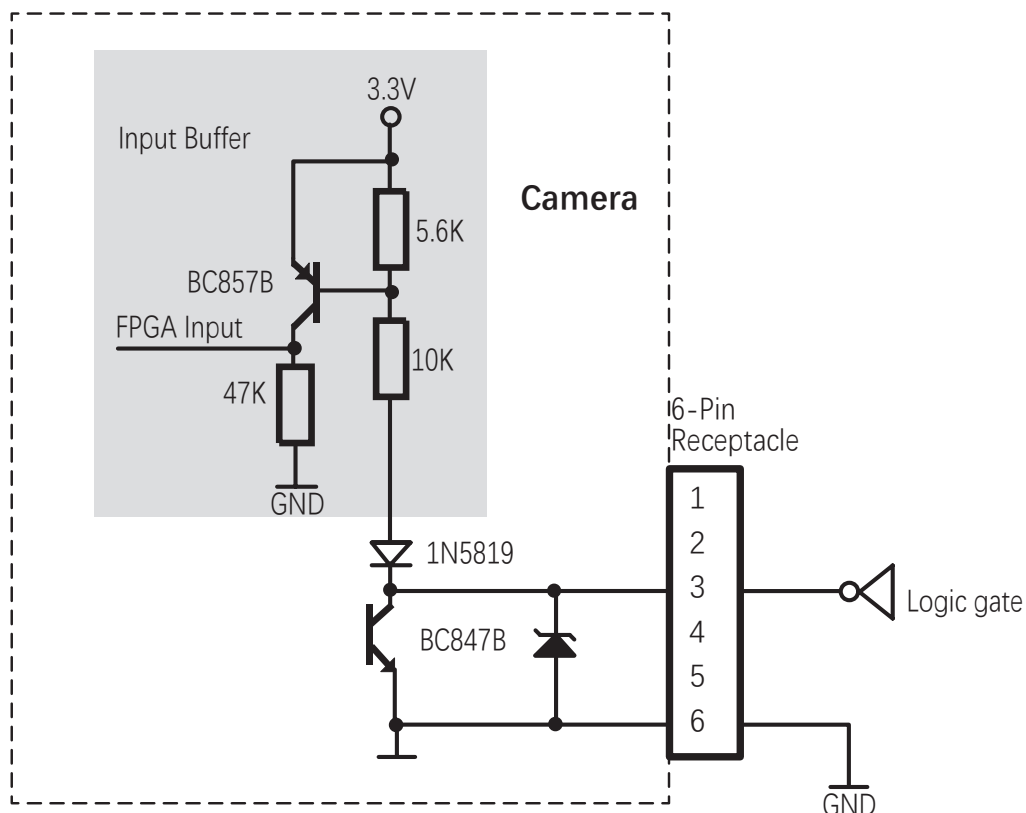


Fig. : Direct-coupled GPIO Line Schematic with the GPIO Line Set as an Input and with a Typical External Circuit Using a Logic Gate (Simplified)

## I/O Electrical Feature

### ■ Operation as an Output

The following I/O supply voltage requirements apply to the direct-coupled GPIO line when it is set as an output.

Input Voltage	Significance
+30.0VDC	Absolute maximum. The absolute maximum must never be exceeded. Otherwise, the camera can be damaged.
+3.3~+24VDC	Safe operating direct-coupled GPIO output supply voltage range.
<3.3VDC	The direct-coupled GPIO output can operate erratically.

**Note:** The maximum current allowed through the output circuit is 50 mA.

As shown in below figure, shows the applicable electrical circuit when a GPIO line is set to operate as an output. The figure is drawn to specifically apply to pin 3 (Line 2) as an example. However, for USB 3.0 cameras, the figure applies equally to pin 1 (Line 3) with the necessary modifications.

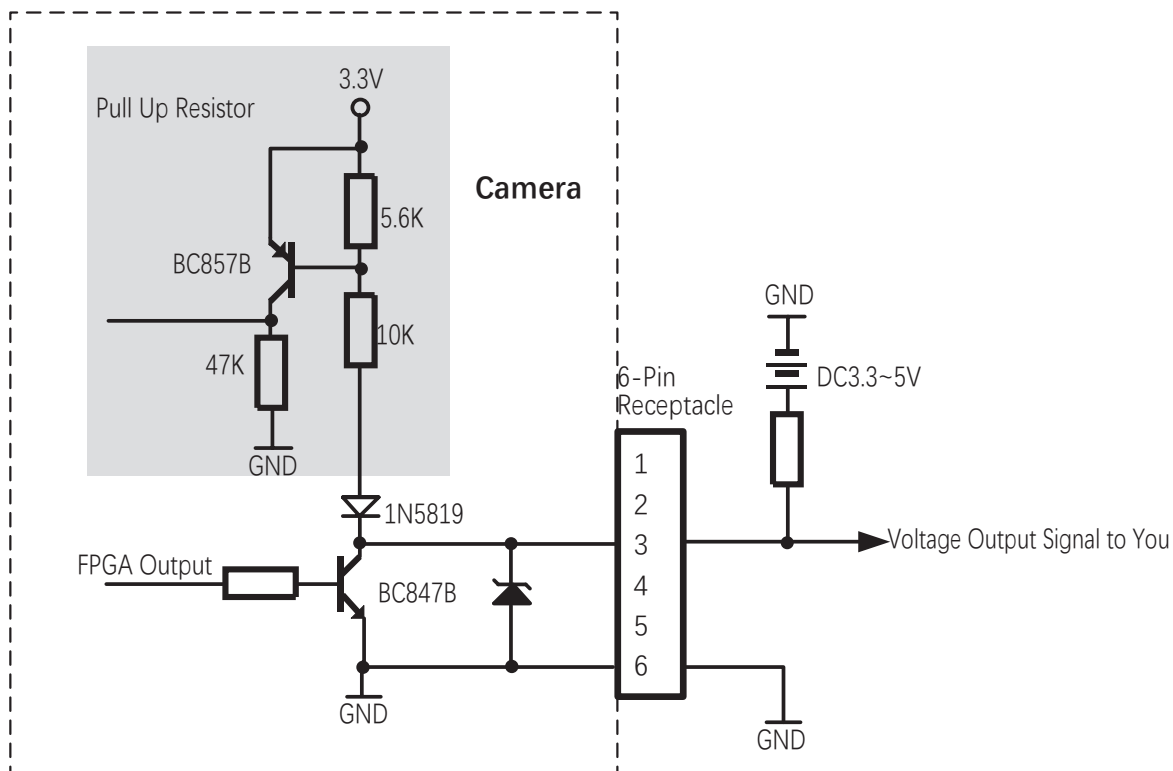


Fig. : Direct-coupled GPIO Line Schematic with the GPIO Line Set as an Output and with a Typical Voltage Output Circuit

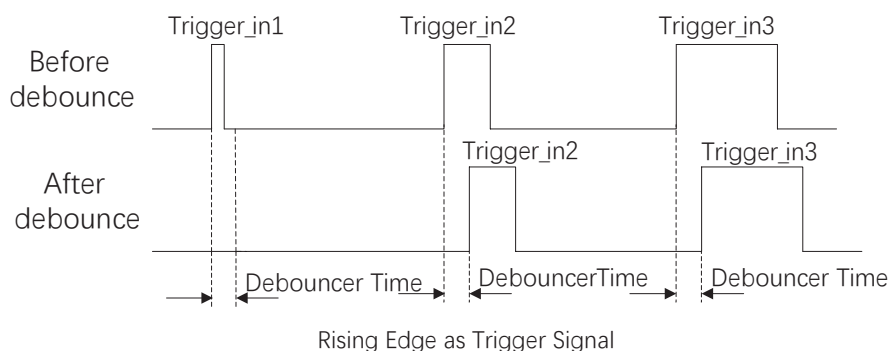
## I/O Electrical Feature

### ■ Trigger Debouncer

The external trigger input signal of the camera may have signal bounce that may cause false trigger. Thus, it is necessary to debounce the external trigger signal, and its sequence diagram is shown below.

It is only supported in the input mode. The level signal of the corresponding interface line is filtered according to the set value; when the value of the signal is less than the debounce value, it will be filtered out.

When the set Debouncer time is greater than the trigger signal time, the trigger signal is ignored.



## CHAPTER 7

## IMAGE PARAMETER

## FFC Correction

In the process of using the area scan camera, it is possible to encounter uneven light, sensor fixed noise and uneven response noise, which will affect the image quality. When these situations are encountered, FFC correction is required.

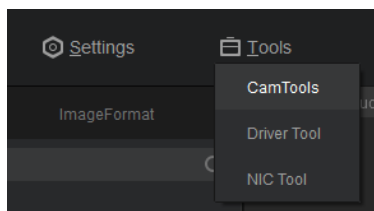
- FFC correction is applied to area scan cameras, mainly to support online FFC correction to ensure image uniformity.
- There are two types of FFC calibration.
  - Point-point: The image will be more accurate and uniform after correction.
  - Surface-to-surface (16 × 16): used for small area scan cameras.
- FFC works by combining three ways.
  - Dark field, fixed image noise correction.
  - Bright field, image non-uniformity response correction.
  - Bright field, non-uniformity correction of lens and light source.



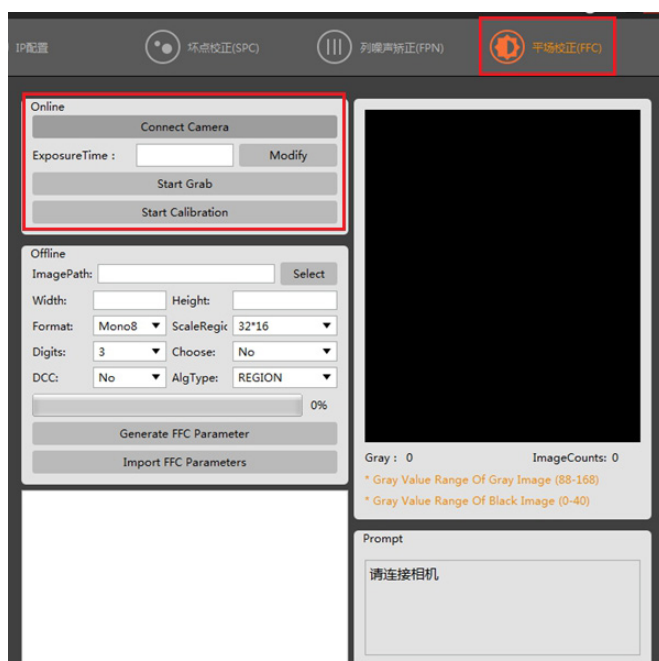
The difference between the brightness and darkness of the image that needs FFC correction cannot be more than twice.

Steps:

- At the top of iCentral, select Tools-Camera Tools to enter Camtools.



- In the upper right corner, select Flat Field Correction (FFC) to enter the flat field correction interface.
- After entering the interface, there will be a step-by-step instruction in the lower right corner. Follow the step-by-step instructions to complete the FFC.



## Black Level

The camera supports the black level function. The black level can adjust the gray value offset of the output data, which determines the average gray value when the sensor is not sensitive. For different ADC bit depth modes, the black level parameter range of the camera is different. Please refer to the actual situation for details.

If you need to set the black level, the specific steps are as follows:

- Set the Black Level Enable parameter under the Analog Control property to "once" or "continuous".
- Enter the value to be set in the Black Level parameter.



The black level function may differ by camera models.

## White Balance

White balance is only available for color cameras.

The white balance refers to the camera color adjustment depending on different light sources. Adjust the Gain Value of the image's R channel and B channel to keep white regions white under different color temperatures. Ideally, the proportion of R channel, G channel and B channel in the white region is 1:1:1.

The camera supports 3 types of white balance modes: Off, Once and Continuous.

White Balance Mode	Parameter	Principle
Off	AnalogControl > BalanceWhiteAuto	You need to set the R, G, B value manually, between 1 and 4095. 1024 means ratio is 1.0
Once		Automatic white balance once. Adjust the white balance for a certain amount of time then stop. It implements an algorithm that finds possible gray areas in the Bayer data.
Continuous		Continuous automatic white balance. It implements an algorithm that finds possible gray areas in the Bayer data.

It is recommended to correct white balance when there is great difference between the camera's color effect and actual effect. You can correct white balance as shown below.

Steps:

1. Put a white paper in the range of the camera's field of view, and make sure the paper covers the entire field of view.
2. Set exposure and gain. It is recommended to set image brightness value between 120 and 160.
3. Select Once as Balance White Auto, and the camera will automatically adjust white balance for once.
4. Select the BlackRatioSelector attribute to select the color channel to be adjusted in R/G/B. Select the value of BalanceRatio and adjust it to a suitable value. The range covers 0-15, and R/G/B is the same. At this time, the image color is close to the actual color, and the white balance calibration is completed. At this time, the image color is close to the actual color, and the white balance calibration is completed.



- In order to avoid repeated correction after rebooting the camera, it is recommended to save white balance parameter to User Set after white balance correction. You can refer to the Section Save and Load User Set for details.
- If the light source and color temperature in environment change, you need to correct white balance again.



## Gain

The camera has 2 types of gain, including the analog gain and digital gain. The analog gain is applied before the signal from the camera sensor is converted into digital values, while digital gain is applied after the conversion.

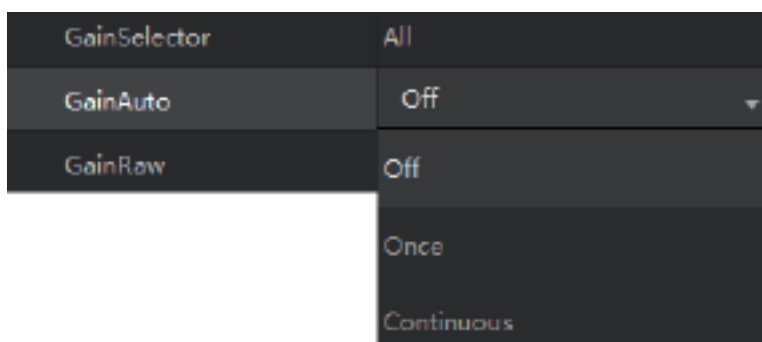
When increasing the analog gain, the image noise will increase too, which will influence image quality. If you want to increase image grayscale value, it is recommended to increase the camera's exposure time. If the exposure time reaches its upper limit, and at this point, you can increase analog gain.

### ■ Analog Gain

The gain function may differ by camera models.

The camera supports 3 types of analog gain modes: Off, Once and Continuous. Click AnalogControl, and select GainAuto according to actual demands. The analog gain mode and principle are shown below.

Gain Mode	Parameter	Principle
Off	AnalogControl > GainAuto	The camera adjusts gain according to the value configured by user in Gain.
Once		Adjust the gain automatically according to the image brightness. After adjusting, it will switch to Off Mode.
Continuous		Adjust the gain continuously according to the image brightness.



### ■ Digital Gain

The camera digital gain is 0 by default and is not enabled. The parameter value range covers 0 ~ 4. The larger the value, the stronger the gain, the brighter the brightness, and the more noise.

If you need to set the digital gain, the specific steps are as follows:

\_ Under the AnalogControl property, enter the number to be set in the DigitalShift parameter, as shown in the figure below.

## Gamma

The camera supports Gamma correction, which is used to correct a non-linear correction of the image data due to the non-linear response of the display, etc. The smaller the Gamma value, the brighter the image. The range of Gamma coefficient covers 0 ~ 3.99998, as shown in the figure below.

The camera does not enable this function by default.

Steps.

- \_ GammaEnable select True, Gamma value can be selected.
- \_ Adjust the Gamma value to make the image brightness meet the requirements.
- \_ When GammaEnable is False, the Gamma value cannot be selected.



Gamma and LookUpTable are mutually exclusive. If Gamma is turned on, LUT will not take effect; for LUT to take effect, Gamma needs to be set to 1.

## Test Pattern

The camera supports test pattern function. When there is exception in real-time image, you can check whether image of test mode have similar problem to determine the reason. This function is disabled by default, and at this point, the outputted image by the camera is real-time image. If this function is enabled, the outputted image by the camera is test image.

Click ImageFormatControl > Test Pattern, and set Test Pattern according to actual demands

The camera offers 6 test patterns, including Mono Bar, Checkboard, Oblique Mono Bar, Gradual Mono Bar, Vertical Color Bar and Horizontal Color Bar.



The pattern may differ by camera models.



Fig:Mono Bar

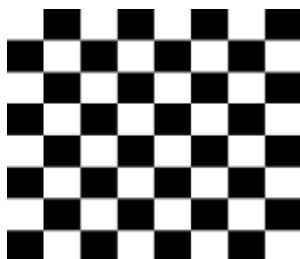


Fig:Checkboard



Fig:Oblique Mono Bar

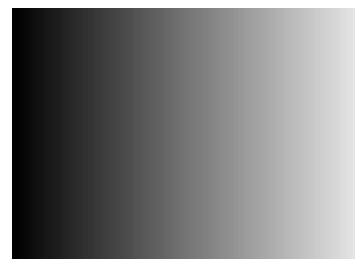


Fig:Gradual Mono Bar

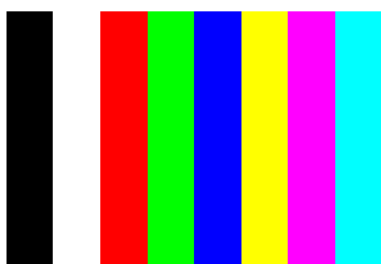


Fig:Vertical Color Bar



Fig:Horizontal Color Bar

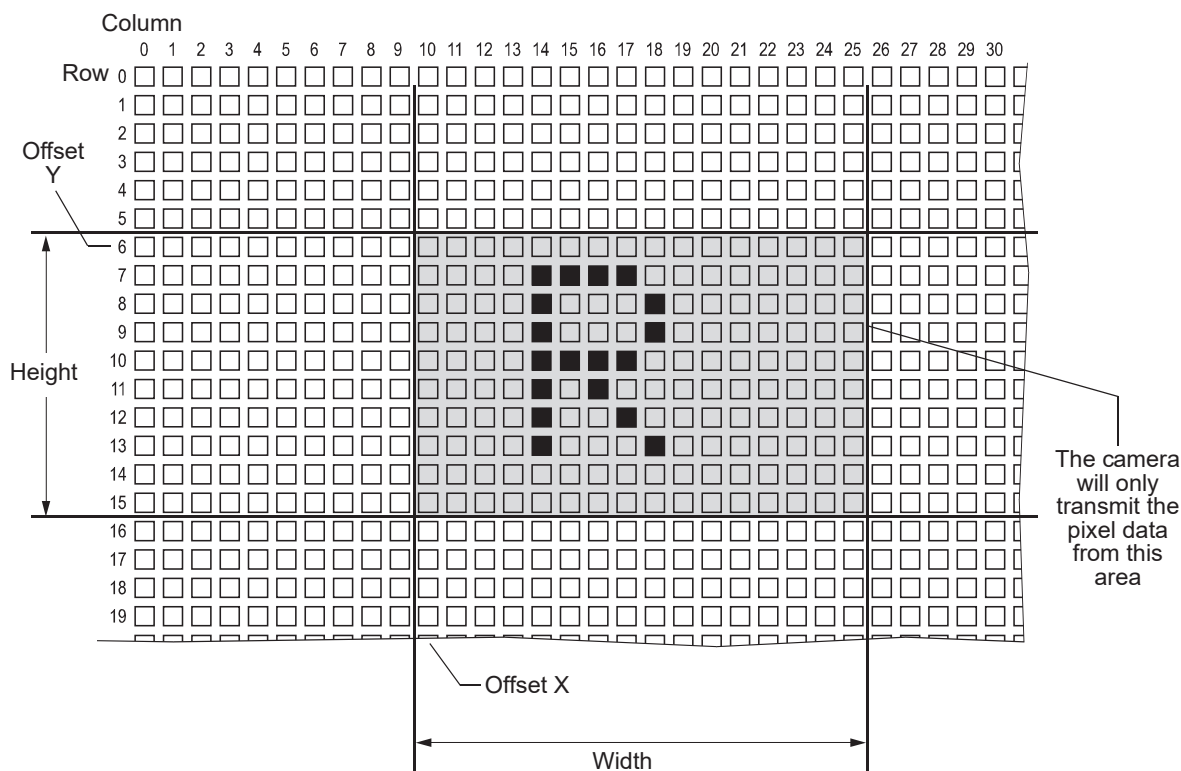
## AOI

The image Area of Interest (AOI) feature lets you specify a portion of the sensor array and after each image is acquired, only the pixel information from the specified portion of the array is read out of the sensor and into the camera's image buffer.

The area of interest is referenced to the top left corner of the sensor array. The top left corner is designated as column 0 and row 0 as shown in below figure.

The location and size of the area of interest is defined by declaring an offset X (coordinate), a width, an offset Y (coordinate), and a height. For example, suppose that you specify the offset X as 10, the width as 16, the offset Y as 6, and the height as 10. The area of the array that is bounded by these settings is shown in below figure.

The camera will only transmit pixel data from within the area defined by your settings. Information from the pixels outside of the area of interest is discarded.



One of the main advantages of the AOI feature is that decreasing the height of the AOI can increase the camera's maximum allowed acquisition frame rate.

### Setting the AOI

You can change the size and the position of the AOI by changing the value of the camera's OffsetX, OffsetY, Width, and Height parameters.

- Offset X: determines the starting column for the area of interest.
- Offset Y: determines the starting row for the area of interest.
- Width: determines the width of the area of interest.
- Height: determines the height of the area of interest.

For general information about the sensor size and the resolution, please refer to the camera datasheet.

## Reverse Image

The camera's reverse X and reverse Y functions let you flip the captured images horizontally and/or vertically before they are transmitted from the camera.

Note that the reverse X and reverse Y functions may both be enabled at the same time if so desired.

### Reverse X

The Reverse X feature is a horizontal mirror image feature. When the Reverse X feature is enabled, the pixel values for each line in a captured image will be swapped end-for-end about the line's center.

Below shows a normal image on the left and an image captured with reverse X enabled on the right.



### Reverse Y

The Reverse Y feature is a vertical mirror image feature. When the Reverse Y feature is enabled, the lines in a captured image will be swapped top-to-bottom.

Figure shows a normal image on the left and an image captured with reverse Y enabled on the right.



You can enable the Reverse X and Reverse Y features by setting the ReverseX and the ReverseY parameter values via iCentral. You can also use the API to set the parameter values from within your application software.

## CHAPTER 9

## OTHER FUNCTIONS

## Configuration Sets

A configuration set is a group of values that contains all of the parameter settings needed to control the camera. There are three basic types of configuration sets: the active set, the default set, and user sets.

**Active Set:** The active set is the camera's current parameter settings. It is located in the camera's volatile memory and the settings are lost if the camera is reset or if power is switched off.

**Default Set:** The default set is the camera's factory optimized configuration. It is saved in a permanent file in the camera's non-volatile memory. It is not lost when the camera is reset or switched off.

**User Sets:** There are two reserved areas in the camera's non-volatile memory available for saving configuration sets. A configuration set saved in a reserved area is commonly referred to as a "user set".

The two available user sets are called User Set 1 and User Set 2.

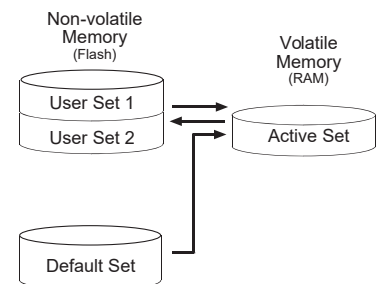
### ■ Saving User Sets

Saving the current active set into a user set in the camera's non-volatile memory is a three step process:

- Make changes to the camera's settings until the camera is operating in a manner that you would like to save.
- Set the UserSetSelector parameter to UserSet1, or UserSet2.
- Execute a UserSetSave command to save the active set to the selected user set.

Saving an active set to a user set in the camera's non-volatile memory will overwrite any parameters that were previously saved in that user set.

You can set the UserSetSelector parameter and execute the UserSetSave command via iCentral. You can also set the parameters from within your application software by using the API that we provide.



### ■ Loading Saved Set or the Default Set into the Active Set

If you have saved a configuration set into the camera's non-volatile memory, you can load the saved set from the camera's non-volatile memory into the camera's active set. When you do this, the loaded set overwrites the parameters in the active set. Since the settings in the active set control the current operation of the camera, the settings from the loaded set will now be controlling the camera.

You can also load the default set into the camera's active set.

To load an UserSet or the default set into the active set:

- Set the UserSetSelector parameter to UserSet1, UserSet2, or Default.
- Execute a UserSetLoad command to load the selected set into the active set.

You can set the UserSetSelector parameter and execute the UserSetLoad command via iCentral. You can also set the parameters from within your application software by using the API that we provide.



Loading a user set or default set into the active set is only allowed when the camera is idle, i.e. when it is not acquiring images continuously or does not have a single image acquisition pending.

Loading the default set into the active set is a good course of action, if you have grossly misadjusted the settings in the camera and you are not sure how to recover. The default set is optimized for use in typical situations and will provide good camera performance in most cases.

## Trouble Shooting

Trouble:

### ■ No camera found when running the iCentral

- Possible Reason1: Camera is not started up normally  
 Solution1: Check camera power wiring (observe the indicator)  
 Possible Reason2: Network cable connection error  
 Solution2: Check network connection

### ■ Camera connection error

- Possible Reason1: Camera and client software are not in the same network segment  
 Solution1: Edit its IP address  
 Possible Reason2: The camera has been connected by another program  
 Solution2: Reconnect after disconnecting the camera from other programs

### ■ Live view is black

- Possible Reason1: Aperture is closed  
 Solution1: Open the aperture  
 Possible Reason2: Camera exception occurs  
 Solution2: Reboot the camera.

### ■ Live view is normal, but the camera cannot be triggered.

- Possible Reason1: Trigger mode is not enabled  
 Solution1: Check whether the camera trigger mode and related trigger signal input are normal in the current environment.  
 Possible Reason2: Incorrect wiring  
 Solution2: Check whether the wiring is correct under corresponding triggering mode.

## CHAPTER 10 TECHNICAL SUPPORT

If you need advice about your camera or if you need assistance troubleshooting a problem with your camera, it's highly recommended to describe your issue in details and contact us via E-mail at [support@contrasttech.com](mailto:support@contrasttech.com)

It would be helpful if you can fill-in the following table and send to us before you contact our technical support team.

Camera Model:		Camera's SN:	
Describe the issue in as much detail as possible:			
If known, what's the cause of the issue?			
How often did/does the issue occur?			
How severe is the issue?			
Parameter set	Please connect the camera directly to PC and use iCentral to make note of the parameter when the issue occurred.		

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