微图视觉
Vision Datum

iBoostX Series SWIR Camera User Manual

Dec.2024

1.Camera Functions and Features

1.1 10G / 5G / 2.5G / GigE Camera Description

- GigE version of the camera, to reach the highest frame rate you need to turn on the network card's jumbo frame mode.
- Ensure that the IP addresses of the GigE camera and the PC-side NIC are in the same network segment.
- Support multiple cameras working at the same time, and synchronized acquisition through the external trigger interface.

1.2 CameraLink Camera Description

- Cameralink cameras use Geometry_1X4_1Y mode for data transfer, 12bit cameras in Medium mode and 14bit cameras in Full mode.

1.3 Camera Capture Mode

- Camera operation mode support: Video Mode or Trigger Mode.
- Camera trigger mode supports: Soft Trigger Mode(Software) or External Trigger Mode(Isolated input, GPIO0, GPIO1, Counter or PWM).

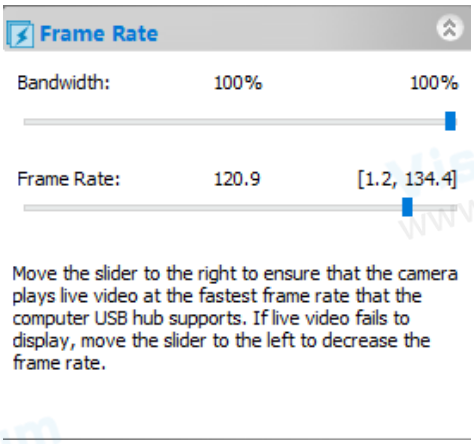
1.4 Bit Depth and ROI Control

- The SWIR series has a built-in 12bit / 14bit ADC, and the cameras also support hardware ROI.The smaller the ROI size, the faster the frame rate.

1.5 Bandwidth and Precise Frame Rate Control

1.5.1 Bandwidth

SWIR cameras supports bandwidth adjustment from 1% to 100%. As shown in the following figure, the camera is with 100% bandwidth by default, and you can drag the slider to set the desired bandwidth.



1.5.2 Precise Frame Rate Control

SWIR cameras series supports precise frame rate control. The frame rate range will vary based on bandwidth,bit depth, resolution, ROI. As shown in the following figure, the current frame rate can be set by dragging the Bandwith or Frame Rate slider bar left or right.

1.6 DDR3 Buffer

- SWIR camera has a built-in 512MB DDR3 buffer, which can effectively improve the stability of USB3 / GigE data transmission and ensure that the camera does not lose frames when working.

1.7 Binning

- SWIR camera supports additive or averaged 1x1 to 8x8 digital binning, and averaged 1x1 to 2x2 hardware binning. Hardware binning can achieve higher frame rates than software binning.

1.Camera Functions and Features

1.8 DC12V Power Supply and Cooling System

- When the DC12V power supply is plugged in, both the camera cooling system and the imaging system use a unified 12V power supply.
- For the USB camera, when the DC12V power supply is disconnected, the camera cooling system stops working, and the imaging system will automatically switch to the USB 5V power supply and the camera can work normally in passive cooling mode.
- For GigE and CameraLink cameras, the imager does not work when the DC12V power supply is disconnected.
- The cooling system has a built-in or external TEC cooling for the sensor. It uses an external heat dissipation structure and a fan to assist heat dissipation. The working temperature can be adjusted to a specific value, and the effective cooling temperature can be lower than the ambient temperature by 10 - 25℃ . The efficient cooling system guarantees extremely low dark current levels.
- The TEC system is controlled by PID algorithm, so that the TEC can be accurately adjusted to the target temperature, and the temperature deviation is 0.1℃ .

1.9 Camera Performance Analysis Methods

- Camera performance can be evaluated in terms of e-/ADU, Readout Noise, Full Well Charge, and Dynamic Range.
- e-/ADU: The conversion factor by which the gain electrons of a CCD/CMOS camera are converted to a digital signal through a series of circuits such as readout, amplification, and analog-to-digital converter. The conversion factor is called ADU.
- Readout Noise: Readout noise is the most important reference for measuring camera performance. Low readout noise usually means better signal-to-noise ratio and better image quality. Readout noise is generated during the readout process when the electrons produce an image through the steps of analog-to-digital conversion, amplification and processing.
- Full Well: The maximum capacity of electrons that each pixel of a camera can hold. The larger the full well charge capacity of the sensor, the wider the dynamic range under the same conditions of noise and A/D conversion.
- Dynamic Range: Dynamic range is the maximum signal divided by the camera noise, where the signal strength is determined by the full-well charge, and the noise is the sum of dark noise and readout noise. Dynamic range indicates the camera's ability to display the brightest and darkest parts of an image and how much it varies between the two. There may be a portion of an image that is completely black and another portion that is completely saturated.
- For the SWIR series, when describing camera performance, the Gain Value is in xxx% mode, where xxx is used as the x-axis (Gain Value)

$$\text{Rel Gain(dB)} = 20 * \log_{10}[\chi\chi\chi(\text{Gain Value})/100]$$

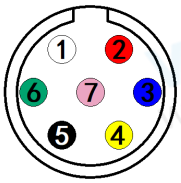
$$\text{xxx(Gain Value)} = 100 \times 10^{(\text{Rel Gain(dB)})/20}$$

For specific performance of the camera, please refer to the parameter indicators of each model or series.

2. External IO interface definition and electrical characteristics

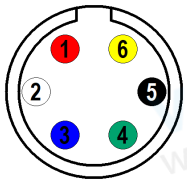
2.1 SWIR 400-1700 camera pin signal definitions

2.1.1 USB Interface, GigE Interface, CL Interface Cooling Camera Pin Signal Definitions



Color	Pin	Signal	Signal Description
White	1	GDN	Direct-coupled signal ground
Red	2	12V	12VDC power input
Blue	3	OPTO_GND	Opto-isolated signal ground
Yellow	4	DIR_GPIO0	Direct-coupled General Purpose I/O (Software configurable input/output) (line2)
Black	5	DIR_GPIO1	Direct-coupled General Purpose I/O (Software configurable input/output) (line3)
Green	6	OPTO_IN	Opto-isolated input signal (line0)
Pink	7	OPTO_OUT	Opto-isolated output signal (line1)

2.1.2 USB Interface Uncooled Camera (Lite) Pin Signal Definitions

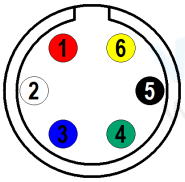


Color	Pin	Signal	Signal Description
Red	1	DIR_GPIO	Direct-coupled General Purpose I/O (Software configurable input/output) (line2)
White	2	OPTO_GND	Opto-isolated signal ground
Blue	3	OPTO_OUT	Opto-isolated output signal (line1)
Green	4	OPTO_IN	Opto-isolated input signal (line0)
Black	5	GND	Direct-coupled signal ground
Yellow	6	5V	5 VDC power input

2. External IO interface definition and electrical characteristics

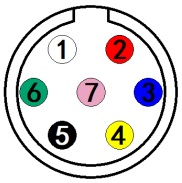
2.2 SWIR 900-1700 camera pin signal definitions

2.2.1 DC12V pin signal definitions



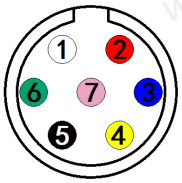
Color	Pin	Signal	Signal Description
Red	1	12V	12V power supply positive
Yellow	6		
Black	5		
White	2	GND	12V power supply negative
Blue	3		
Green	4		

2.2.2 CL Interface Trigger pin signal definitions



Color	Pin	Signal	Signal Description
Blue	3	OPTO_GND	Opto-isolated signal ground
Green	6	OPTO_IN	Opto-isolated input signal (line0)
Pink	7	OPTO_OUT	Opto-isolated output signal (line1)

2.2.3 GigE Interface and USB Interface Trigger pin signal definitions



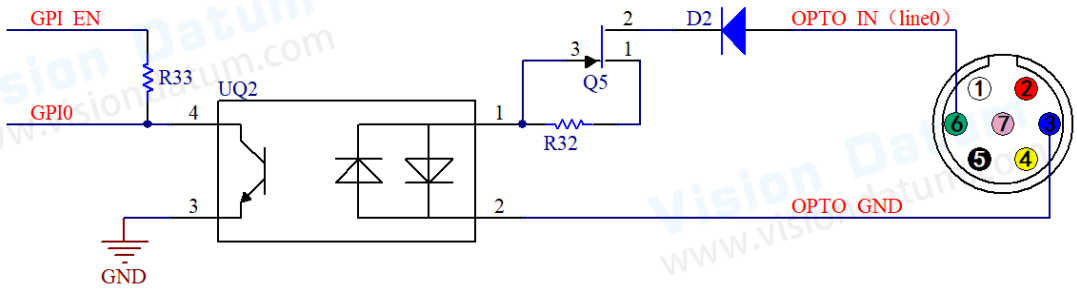
Color	Pin	Signal	Signal Description
White	1	GDN	Direct-coupled signal ground
Red	2	12V	12VDC power input
Blue	3	OPTO_GND	Opto-isolated signal ground
Yellow	4	DIR_GPIO1	Direct-coupled General Purpose I/O (Software configurable input/output) (line2)
Black	5	DIR_GPIO2	Direct-coupled General Purpose I/O (Software configurable input/output) (line3)
Green	6	OPTO_IN	Opto-isolated input signal (line0)
Pink	7	OPTO_OUT	Opto-isolated output signal (line1)

2. External IO interface definition and electrical characteristics

2.3 I/ O Electrical Properties

2.3.1 Opto-isolated Input Circuit (line0)

In the camera I/O control, opto-isolated input circuit is shown in the following figure.

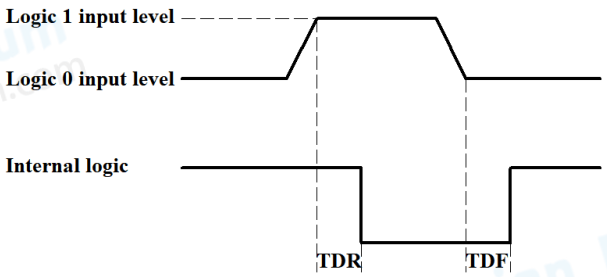


Logic 0 input level: 0~2.2VDC (OPTO_IN pin)

Logic 1 input level: 3.3~24VDC (OPTO_IN pin)

Maximum input current: 30mA

The input level is between 2.2V and 3.2V, the circuit action state is uncertain, please avoid the input voltage working in this range.

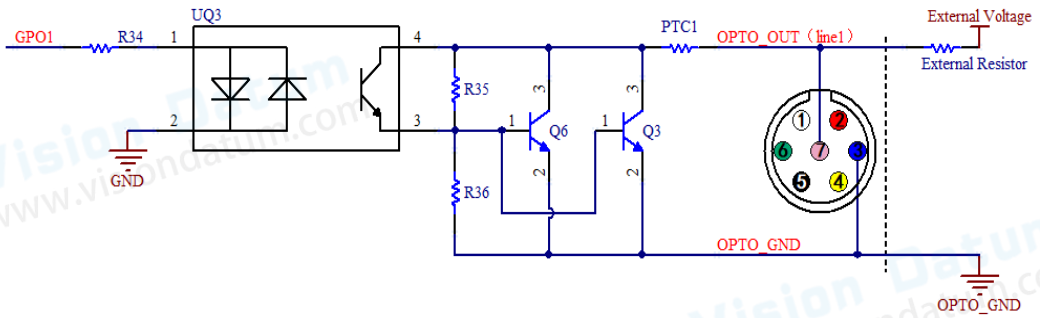


Input rise delay (TDR): 6us

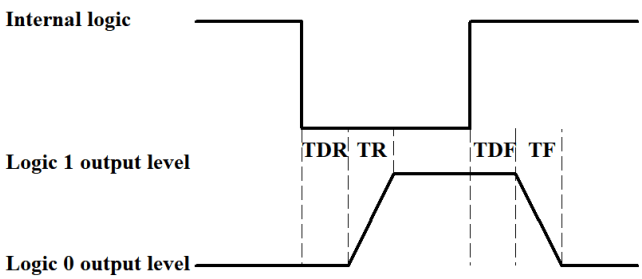
Input drop delay (TDF): 6us

2.3.2 Opto-isolated Output Circuit(line1)

In camera I/O control, opto-isolated output circuit is shown in the following figure.



Opto-isolated output maximum current: 30mA



2. External IO interface definition and electrical characteristics

The electrical characteristics of the opto-isolated output signal (external voltage 5V, external resistor 1K) are shown in the following table.

Parameter name	Parameter symbol	Parameter values
Output logic low level	VL	742mV
Output logic high level	VH	4.134V
Output rise time	TR	4us
Output down time	TF	1.8us
Output rising delay	TDR	12us
Output drop delay	TDF	2us

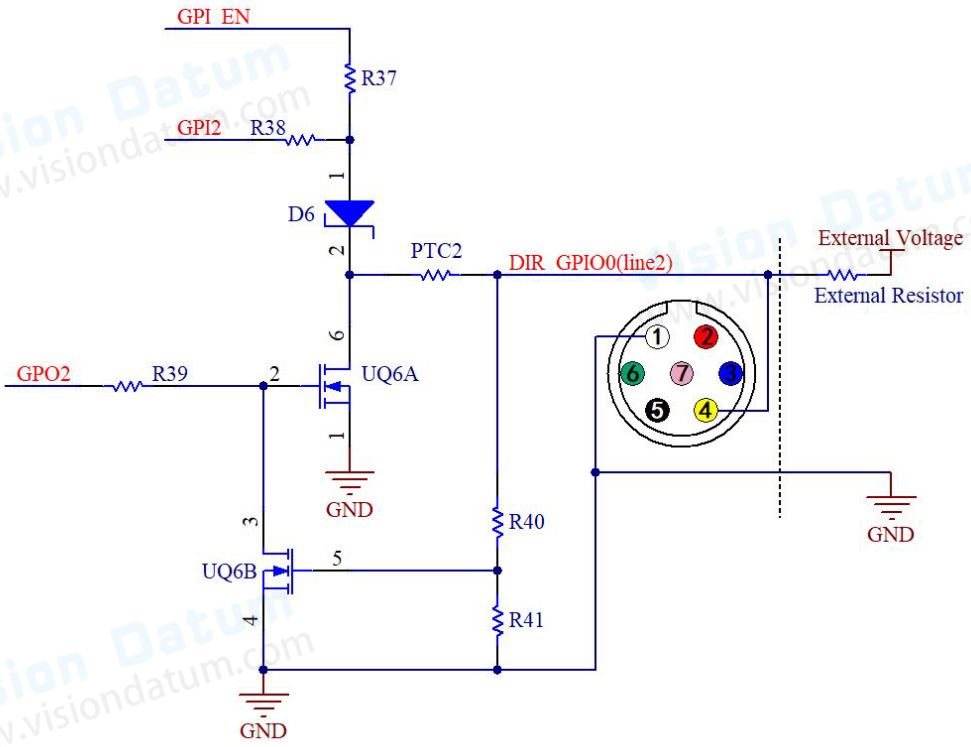
The corresponding current and output logic low level parameters are shown in the following table when different voltage and resistors are used in external circuit.

External voltage	Non-essential resistance	VL	Output current
3.3V	1KΩ	510mV	2.82mA
5V	1KΩ	742mV	4.31mA
12V	2.4KΩ	795mV	4.68mA
24V	4.7KΩ	850mV	4.97mA

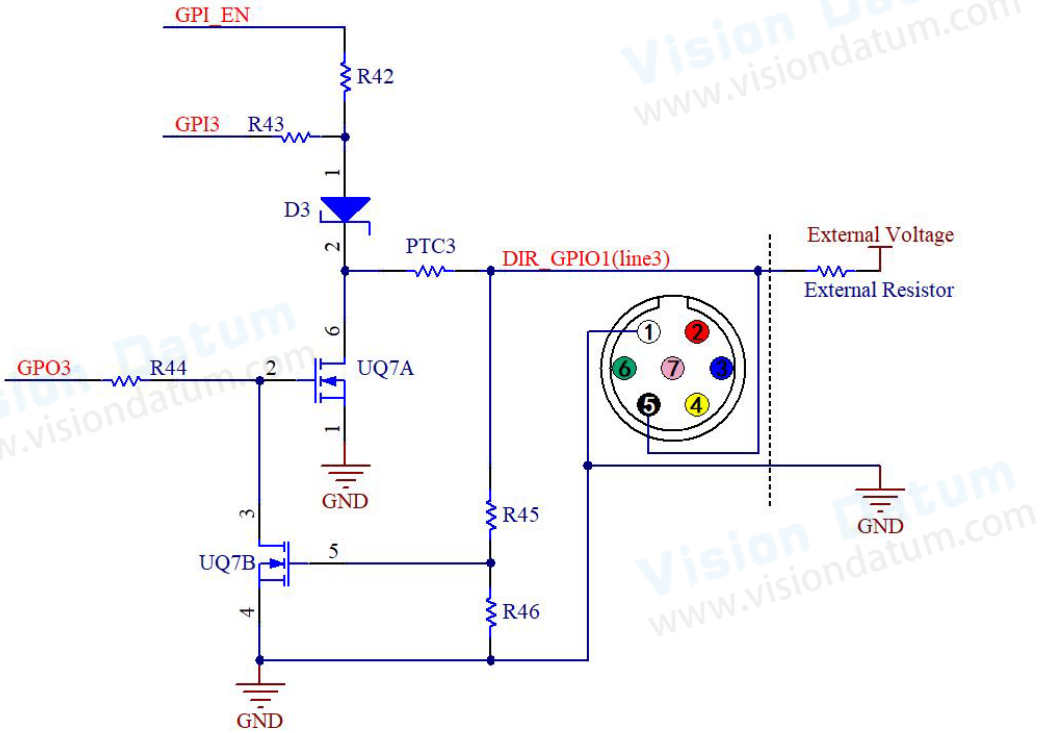
2. External IO interface definition and electrical characteristics

2.3.3 Input and Output I/O Circuit(line2/line3)

Non-isolated configurable input, output I/O circuit (line2) is shown in the following figure.



Non-isolated configurable input, output I/O circuit (line3) is shown in the following figure.



2. External IO interface definition and electrical characteristics

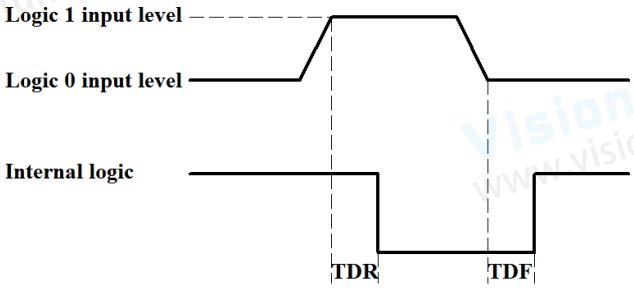
1, Line2/line3 set as input pin:

Logic 0 input level: 0-0.6 VDC (DIR_GPIO1/DIR_GPIO2 pin)

Logic 1 input level: 2.0~24VDC (DIR_GPIO1/DIR_GPIO2 pin)

Maximum input current: 25mA

The input level is between 0.6V and 2.0V, the circuit action state is uncertain. Please avoid the input voltage working in this range.



To prevent damage to the GPIO pin, connect the GND pin before entering voltage to the Line2 pin.

Input rise delay (TDR): 0.02us

Input drop delay (TDF): 0.02us

2. External IO interface definition and electrical characteristics

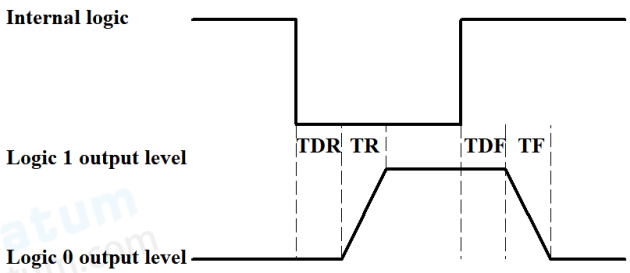
2, Line2/line3 set as output pin

The maximum current allowed through this pin is 25 mA.

When the ambient temperature is 25 degrees Celsius, the relationships between the external voltage, resistance and output low level are shown in the following table.

External voltage	Non-essential resistance	VL (GPIO)
3.3V	1KΩ	0.11V
5V	1KΩ	0.167V
12V	2.4KΩ	0.184V
24V	4.7KΩ	0.385V

The external pull-up voltage 5V pull-up resistance 1KΩ, GPIO output logic level, electrical characteristics are shown in the following figure.



Parameter name	Parameter symbol	Parameter values
Output rise time	TR	0.08us
Output fall time	TF	0.02us
Output rise delay	TDR	0.1us
Output fall delay	TDF	0.04us

3. Application

3.1 Application installation

SWIR series can be used with ASCOM, DirectShow SDK.If the third-party software is compatible with these interfaces, customers can also download software drivers from our website and install them into the third-party software.

3.2 Introduction

iBoostX is a professional software that integrates camera control, image acquisition and processing, image browsing and analysis functions. IBoostX has the following characteristics:

- x86: XP SP3 and above ; CPU supports SSE2 and above
- x64: Win7 and above
- Support video mode and Trigger Mode (Raw format or RGB format)
- Automatic capture and quick recording capabilities
- Supports multiple languages
- Hardware ROI and digital binning capabilities
- Rich image processing functions, such as image stitching, real-time overlay, flat field correction, dark field correction, etc.

3.2.1 User interface design

- The menus and toolbars are properly set to ensure quick operation
- Professionally integrated with 5 sidebars - Camera, Folders, Undo/Redo, Layers, Measure
- Comfortable operation method (double-click or right-click context menu)
- Detailed help manual

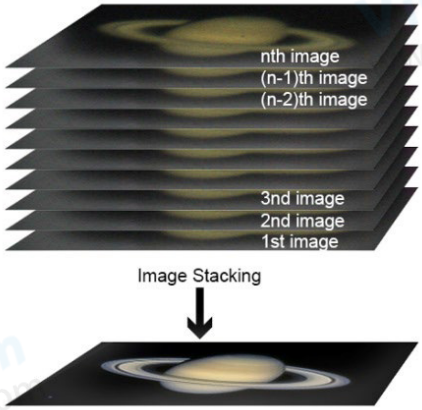
3.2.2 Professional Camera Control Sidebar

Capture & Resolution	Set up live and still capture, snap images, or record video
Exposure & Gain	Auto exposure (preset exposure target value), manual exposure (exposure time can be manually entered and set by slider); gain up to 5 times
White Balance	Advanced one-click smart white balance settings, and you can adjust white balance by manually setting color temperature and color
Color Adjustment	Color, saturation, brightness, contrast, gamma initial high-speed adjustment function
Frame Rate Control	For different computer and USB performance, the camera can be super compatible by adjusting the frame rate
Flip	Select "Horizontal" or "Vertical" to adjust the sample orientation to ensure the same orientation as the visual system
Sampling	Neighborhood averaging can improve the signal-to-noise ratio of the video stream; while the sampling extraction mode can ensure the sharpness of the video stream. Supports histogram expansion of video stream, image negative and positive switching, grayscale calibration, and sharpness factor calculation to facilitate video focusing
Bit Depth	8, 12-bit switching, 8-bit is the basic Windows image format. 12-bit has higher image quality but reduces frame rate
ROI	ROI, Region of interest. This function can set the ROI value of the video window. After the ROI group is expanded, a rectangular box will appear in the middle of the video window, and the ROI can be changed. The mouse can adjust the size of the ROI. If there is no problem with the ROI, click "Apply" to set the video to the size of the ROI, and the default value will be restored to the original size.
Dark Field Correction	To enable darkfield correction, you should first capture a field image, then click Enable. Check Enable to enable darkfield correction. Uncheck it to disable darkfield correction
Cooling	Set TEC Target Temperature, fan on/off
Parameter Save	Load, save, overwrite, load, export custom camera panel controls (including calibration information, exposure parameters and color settings information, etc.)

3. Application

3.2.3 Professional and practical image processing functions

Video Function	Various video professional processing functions: video broadcasting, timing capture, video recording, video watermarking, watermark mobile alignment, watermark rotation alignment, video grid overlay, video measurement, video scaling, gray scale calibration, video high dynamic (HDR), video depth of field extension, video image stitching, video scale, date, etc.
Image Processing and Enhancement	Image contrast control and adjustment, image denoising, various image filtering algorithms, image mathematical morphology algorithms, image rotation, image scaling and image printing, etc.
Image Overlay	The IBoostX image overlay denoising function introduces advanced image matching technology. Users only need to record a short video of the image to be superimposed, and they can superimpose and output high fidelity in the case of displacement, rotation and magnification change between multiple frames of the video. images, easy to use



3.2.4 Super compatibility

Camera Video Interface	Provide Twain, DirectShow, Labview, SDK installation package (native C++, C#)
Supported Platform and architectures	Compatible with Microsoft® Windows® XP / Vista / 7 / 8 /10 /11(32 & 64 bit), Mac OSX, Linux
Language Support	Language support can be added manually, currently supports English, Simplified Chinese, Traditional Chinese, German, Japanese, Russian, French, Italian, Polish, Turkish

3.2.5 Basic hardware requirements

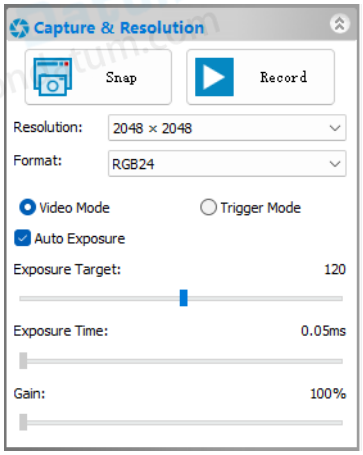
PC Basic Configuration Requirements	• CPU: Intel Core 2 2.8GHz or higher • RAM: 2GB or more • USB Port: USB3.0 / USB 2.0 • Monitor: 17" or higher • CD-ROM

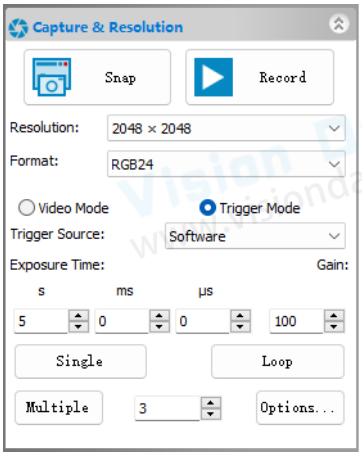
3. Application

3.3 Trigger Mode and its Configuration

3.3.1 Video Mode and Trigger Mode

The trigger function can be found on the Capture & Resolution group on the Camera Sidebar in client. When the camera is opened, it is in Video Mode as shown below on the left. In Video Mode, Auto Exposure, Exposure Target, Exposure Time and Gain can be set. One can switch to Trigger Mode by checking the Trigger

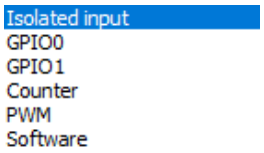


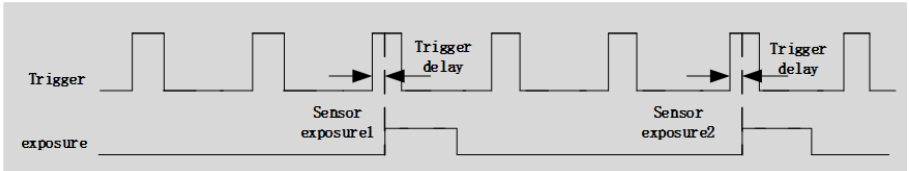


After the Trigger Mode is checked, the Capture & Resolution group will switch to Trigger Mode as shown above on the right. Where, the Trigger Source, Exposure Time, Gain, Single, Loop, Multiple, Frame Box, and Options can be set.

3.3.2 Trigger Sources and Their Capture Style

The Trigger Source can be any external input signal inputted into the camera which is called Hardware (Trigger Source), it can also be a command from the application which is called Software (Trigger Source). For the Software Trigger Source, it can be Single, Loop, Multiple, or Sequence style. The following figure shows the possible Trigger Sources. The following table shows the designed Trigger Source descriptions and possible capture styles for the camera.



Trigger Source	Description
Isolated input	• Logic 0 input level: 0~2.2VDC; • Logic 1 input level: 3.3~24VDC; • Maximum input current: 30mA;
GPIO0	• Logic 0 input level: 0~0.6VDC (DIR_GPIO0/DIR_GPIO1 pins); • Logic 1 input level: 2.0~24VDC (DIR_GPIO0/DIR_GPIO1 pins); • Maximum input current: 25mA; If GPIO0 is chosen as Trigger Source, it should be configurated as Input in the GPIO Mode's combo box on the Options>IO Control page;
GPIO1	• Logic 0 input level: 0~0.6VDC (DIR_GPIO0/DIR_GPIO1 pins); • Logic 1 input level: 2.0~24VDC (DIR_GPIO0/DIR_GPIO1 pins); • Maximum input current: 25mA; • If GPIO1 is chosen as Trigger Source, it should be configurated as Input in the GPIO Mode's combo box on the Options>IO Control page;
Counter	Counter refers to the operation mode in which the camera can divide the frequency of the external input trigger signal through the preset Counter Value and perform image acquisition according to the customer's logic. For example, when the counter value (Counter Value: 3 [1,1023]) is set to 3, thecamera needs to receive 3 trigger signals to trigger once;  When Counter is chosen in Trigger Source combo box in the Capture & Resolution group, the Counter Source can be Isolated input, GPIO0 or GPIO1 which can be chosen on Options>IO Control page; If GPIO0 or GPIO1 is chosen in the Counter Source combo box on Options>IO Control page. It should be configured as Input in the GPIO Mode combo box; Check Options>IO Control page's Line Select related items and Counter related items for details;

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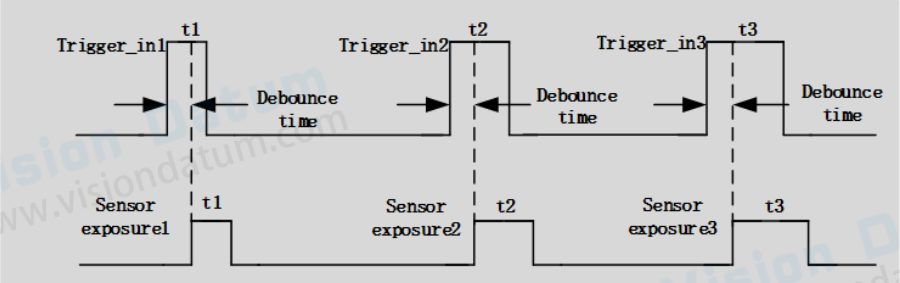
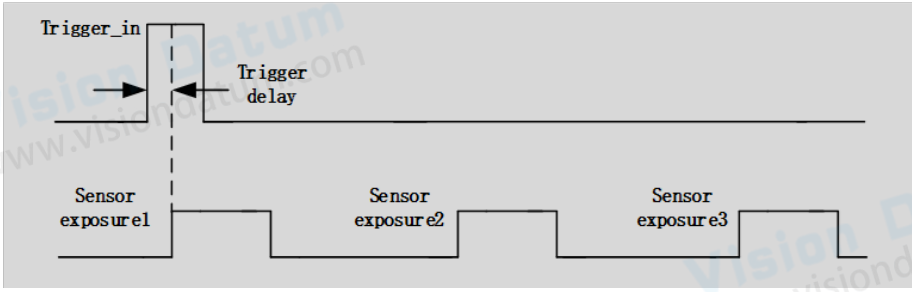
Trigger Source	Description
PWM	PWM refers to the operation mode in which the camera exposure time is controlled by the input trigger signal's pulse width;  PWM Trigger Source can be Isolated input, GPIO0 or GPIO1. If GPIO0 or GPIO1 is chosen in the PWM Source combo box on the Options>IO Control page, it should be configured as Input in the GPIO Mode combo box; Check Options>IO Control page's Line Select related items and PWM related items for details;
Software	• When Software trigger is chosen, the client software can send the command through USB3.0 to trigger, acquire and transfer images, In client, Single, Loop, Multiple, or Sequence can be used to send the Software trigger command; If the Plan or Hardware is chosen in the Type combo box on the Options>Sequence page, the Multiple button will switch to Sequence button and the camera will use the Exposure Time and Gain in the Sequence table on this page one by one to capture the specified frames. Check Single, Loop, Multiple, or Sequence on Capture & Resolution group for the Software capture operations; • Check Options>Sequence page and Options>Advanced page for the related Sequence and Software capture setup options;
Single	When Single is clicked, the camera will start to capture the image. At the same time the Single button will switch to Stop button. Clicking Stop button to stop the current Single capture operation, the Stop button will switch to Single button again for the next capture operation; Note: 1) The captured frames will always Show in the video window to prevent too many captures; 2) Enabled when Software in the Trigger Source combo box is chosen or Always enable software trigger checkbox is checked on the Options>Advanced property page;
Loop	When Loop is clicked, the camera will start to capture the image continuously and the Loop button will switch to Stop button. Clicking Stop button to stop Loop captures and the Stop button will switch to Loop button for the next Loop capture operation; Note: 1)The captured frames will always Show in the video window to prevent too many captures; 2)Enabled to capture continually when Software in the Trigger Source combo box is chosen or Always enable software trigger checkbox is checked on the Options>Advanced property page;
Multiple	Multiple refers to the operation mode in which the camera receives Software trigger signal or command and exports multiple frames of images. An edit box with spin(we call it Frames Box) is designed and affiliated to the Multiple button (Multiple 3 Options...) for the setting of the frames to be captured; The Frames Box can be set in the range of 1~ 65535. If the Frames Box is 3, a three-frame image will be captured and exported;  Note: 1)Multiple capture is enabled to capture continually when Software in the Trigger Source combo box is chosen; 2)Multiple capture is enabled when Always enable software trigger is checked on the Options>Advanced property page, no matter whether Trigger Source is Software or Hardware on the Capture & Resolution group; 3) If the Plan or Hardware is chosen in the Type combo box on the Options>Sequence page, the Multiple button will switch to Sequence button and the camera will use the Exposure Time and Gain in the Sequence table on this page. The captured frames will be displayed either in Show in the video window, or Show in a new window or Save to disk which can be specified on Options>Output page;

3. Application

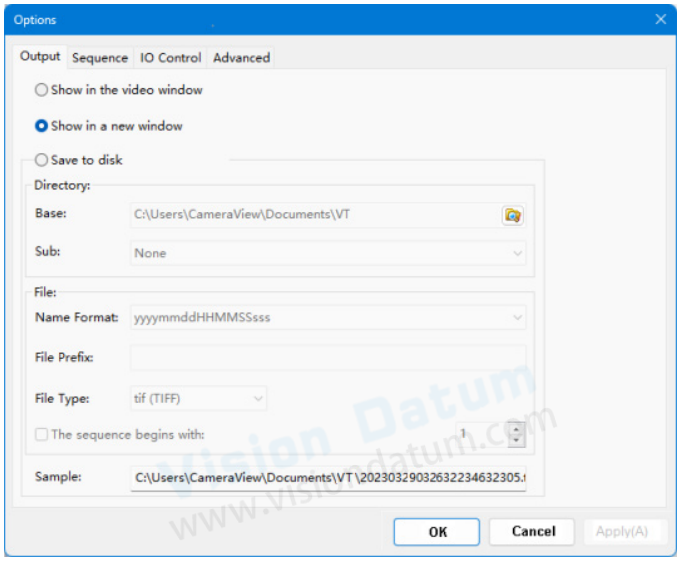
Trigger Source	Description
Sequence	When Sequence is clicked, the camera will start to capture the image until the specified frames in the Frames Box are captured. At the same time the Sequence button will switch to Stop button. Clicking Stop button will stop the current Sequence capture and the Stop button will switch to Sequence again for the next Sequence capture operation; Note: 1) Switched from Multiple to Sequence to capture the specified frames in the edit box with spin(Frames Box) when Plan or Hardware in the Type combo box is chosen on the Options>Sequence property page; 2)If the Plan or Hardware is chosen in the Type combo box on the Options>Sequence page, the Sequence button will be enabled and the capture will use the Exposure Time and Gain in the Sequence table list below one by one on the Options>Sequence page; 3) If the Plan or Hardware is chosen in the Type combo box on the Options>Sequence page and Always enable software trigger is checked on the Options>Advanced property page, the Sequence button will not switch to Multiple button and will be enabled only when the still in Sequence enable 4)If the Plan is chosen in the Type combo box on the Options>Sequence page and the Software is chosen in the Trigger Source combo box, the Sequence button will be enabled. 5)If the Hardware is chosen in the Trigger Source combo box, the Sequence button will be disabled, but the Frame Box will still be enabled and the Sequence will switch to the Hardware Sequence capture. One Hardware trigger signal will capture the specified frames on the Frame Box using the Exposure Time and Gain in the Sequence table on Options>Sequence page; 6)Check Options>Sequence page for the related Sequence setup options;

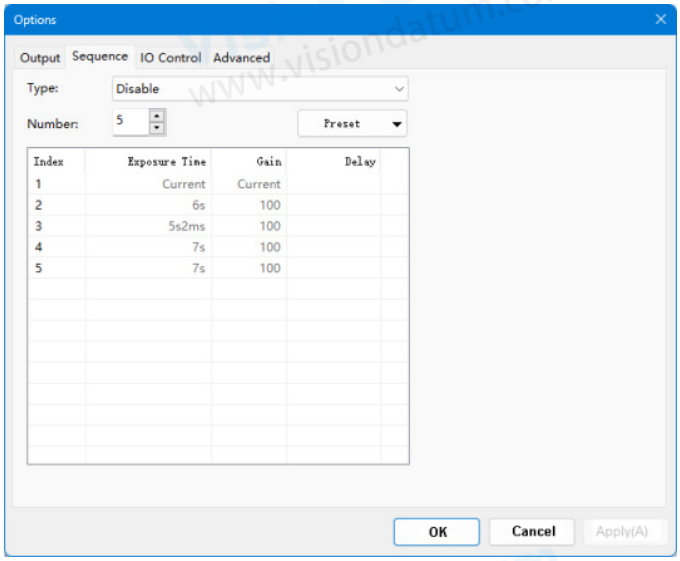
3. Application

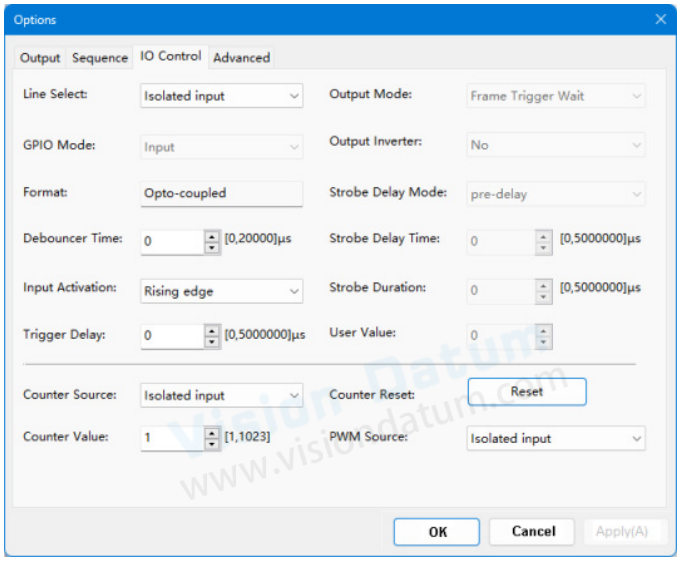
3.3.3 The trigger capture and IO Control configurations

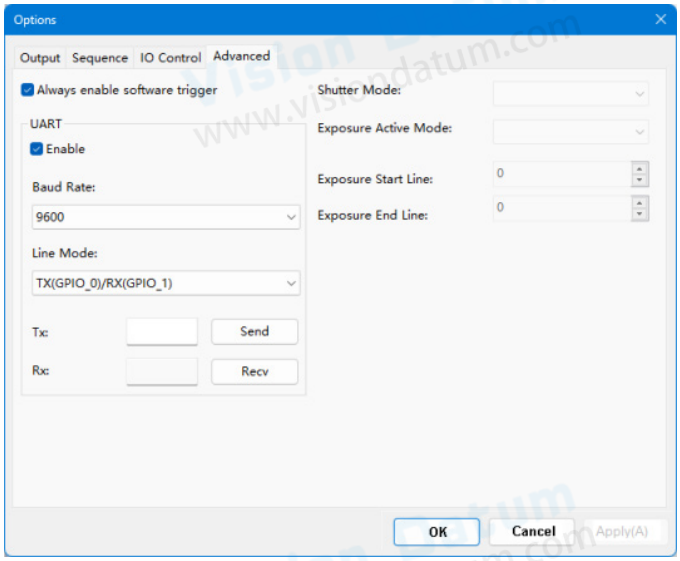
The Trigger Source can be Isolated input, GPIO0, GPIO1(when configured as input), Counter, or PWM which can be configurated on the Options property sheet. Also the camera's Isolated output, GPIO0 or GPIO1(can be configurated as Output) can be used as Output or UART (GPIO0, GPIO1 only) applications. All of these configurations can be realized on the Options property sheet described in table below.

- About the captured file operation style, one can find it on the Option>Output page;
- About the Sequence setup, one can find it on the Option>Sequence page;
- About the camera pin IO Control style, one can find it on the Options>IO Control page;
- About the Always enable software trigger and UART setup, Shutter Mode, and Exposure Active Mode, one can find it on the Options>Advance page.



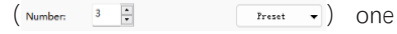
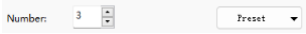
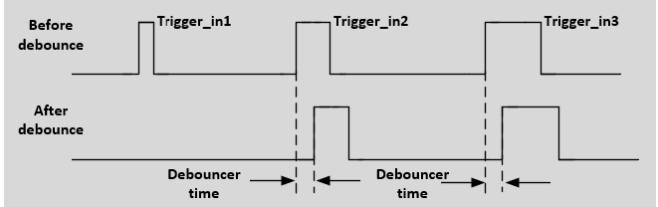




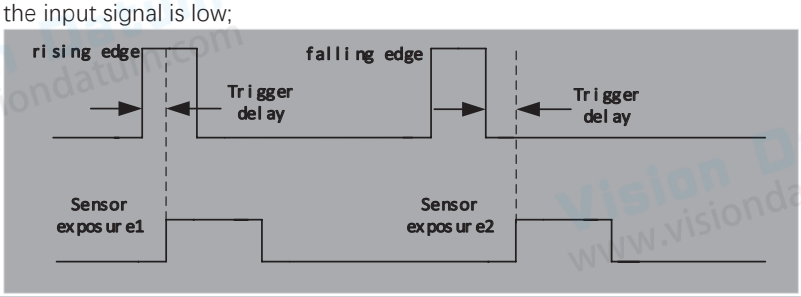
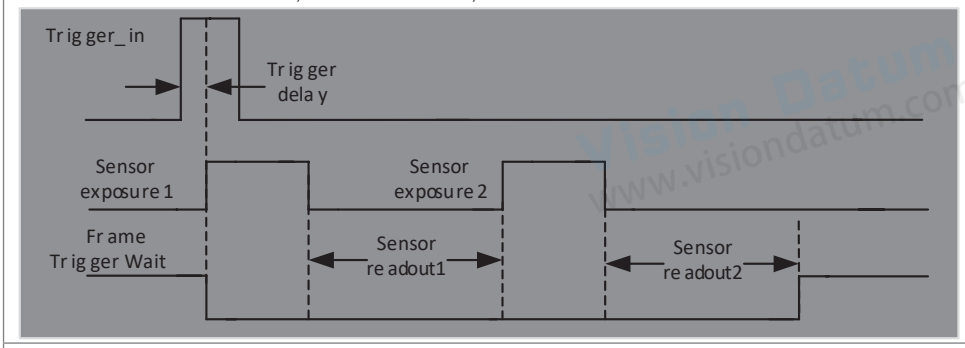
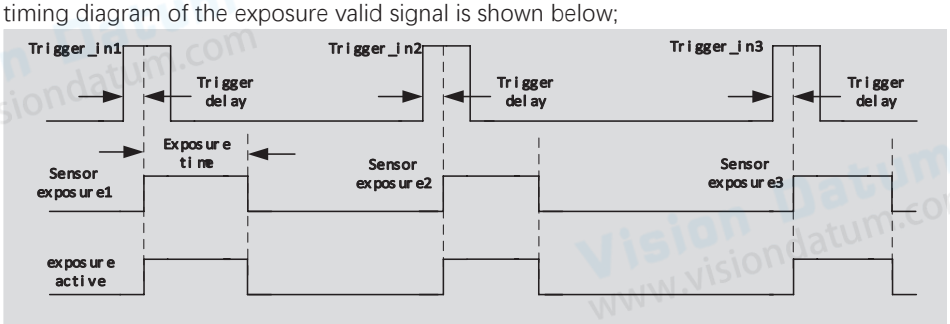
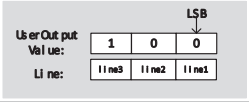


Pages	Items	Descriptions
Output	Output Destination	Used to set the captured frame's Output destination, can be Show in the video window, Show in a new window or Save to disk; When Save to disk is checked, the button will be enabled clicking it to choose the Base directory, clicking the Sub combo box's dropdown button to choose the Sub directory; The File Name Format, File Prefix, File Type, and even The sequence begin with can be chosen, set, or defined. Note: 1)Valid only for Sequence or Multiple capture setup; 2)For Single or Loop capture, the captured image will be always displayed on the video window;

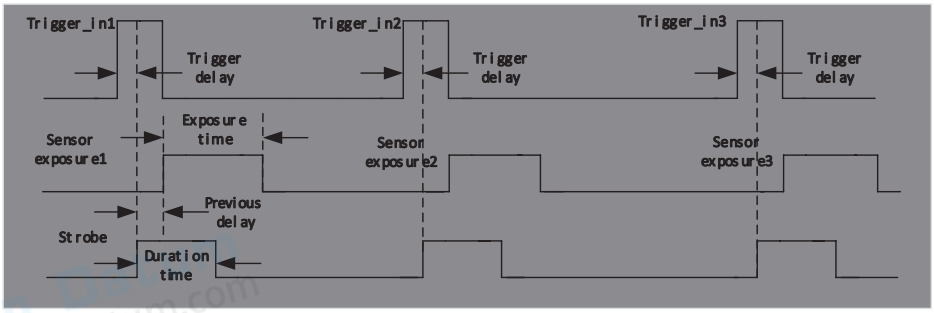
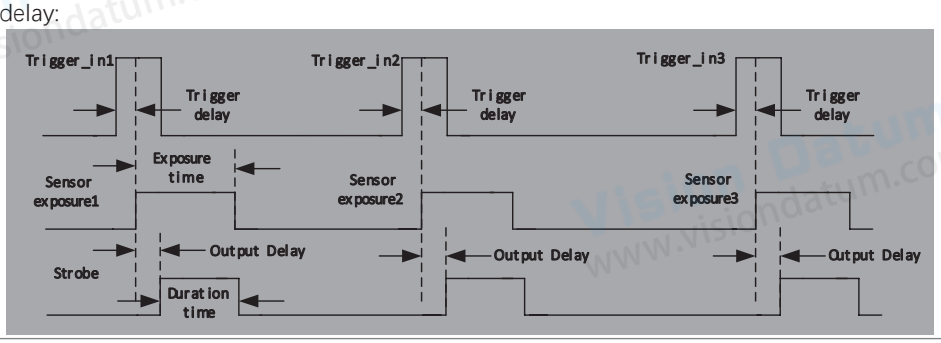
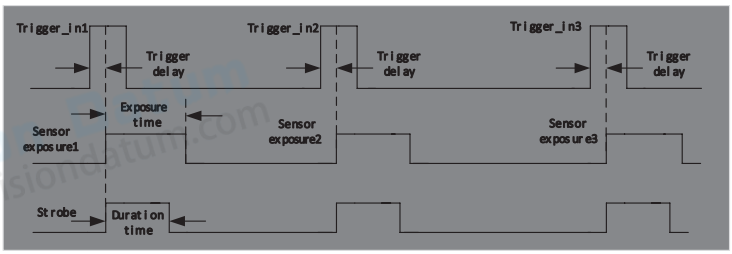
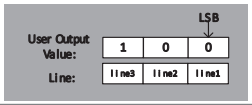
3. Application

Pages	Items	Descriptions
Sequence	Type	• Disable: If the Disable button is chosen in the Type combo box on the Options>Sequence page, the Sequence button on the Capture & Resolution page will switch to Multiple button; • Plan: 1)If Plan is chosen in the Type combo box on the Options>Sequence page, the Multiple button on the Capture & Resolution group will switch to Sequence button; 2) If the Software Trigger Source is chosen in the Capture & Resolution group or the Always enable software trigger is checked on the Options>Advanced property page, the Sequence button will be enabled After the Software trigger signal is arrived(By clicking Single, Loop, or Sequence button), the camera will capture frames specified in the edit box with spin  (we call it Frames Box) affiliated to the Sequence button; The whole captures will use the Exposure Time, Gain and Delay in the Sequence table listunder  one by one by the software; 3) If the Disable button is chosen in the Type combo box on the Options>Sequence page, the Sequence button on the Capture & Resolution page will switch to Multiple button; 4)The Sequence button will be enabled only when a) the Plan in the Type combo box is chosen on the Options>Sequence page and b) he Software Trigger Source is chosen in the Capture & Resolution group or c) Always enable software trigger is checked on the Options>Advanced property page; • Hardware: 1) if Hardware is chosen in the Type combo box on the Options>Sequence page, the Multiple button on the Capture & Resolution group will switch to Sequence button and will be disabled for Hardware trigger. But users can still set the frames number in the Frame Box on the Capture & Resolution group; 2) After the Hardware trigger signal arrives, the camera will capture frames specified in the edit box with spin  (we call it Frame Box) affiliated to the Sequence button; The whole capture will use the Exposure Time, Gain (Delay is not used) in the Sequence table list under  one by one but stored in the camera hardware for the quick operation; 3) If the Disable button is chosen in the Type combo box on the Options>Sequence page, the Sequence button on the Capture & Resolution page will switch to Multiple button. 4)The Sequence button is always disabled if a) The Hardware is chosen in the Type combo box on the Options>Sequence page and b)the Hardware Trigger Source is chosen in the Capture & Resolution group; 5) The Sequence button will be enabled if a) the Software Trigger Source is chosen in the Capture & Resolution group or b) the Always enable software trigger checkbox is checked on the Options>Advanced property page, in this case, both the Plan and Hardware Sequence capture are supported;
	Number	The possible Sequence(capture) frames to be captured. If the Number is larger than the Sequence Number in the Frames Box on the Capture & Resolution group, the other Indices will be executed at the next Sequence operation one by one recycled;
	Index	The order of the Number group;
	Exposure Time	The camera Exposure Time for the specified capture Index in the Sequence capture;
	Gain	The camera Gain for the specified capture Index in the Sequence capture;
	Delay	The Delay time for the specified capture Index in the Plan Sequence capture(Valid for Plan Sequence capture only);
	Preset	Choosing Save to save the current Sequence table's settings; Clicking Management to Rename the saved Sequence table's setting files or Remove them from the Management list;
IO Control	Line Select	Choosing which line to set. Can be Isolated input, Isolated output, GPIO0 or GPIO1 et al;
	GPIO Mode	To configure whether the line selected in Line Select is for Input or Output. Only GPIO0 or GPIO1 can be configured as either Input or Output; If Isolated input or Isolated output is chosen, the GPIO Mode will be specified as Input or Output (Not configurable) respectively;
	Format	Specify the current selected signal's Format in the Line Select combo box, can be Opto-coupled(Isolated input, Isolated output)or TTL (GPIO0 or GPIO1)for clarity(Unconfigurable);
	Debouncer Time	Since there may be a glitch in the external trigger input signal if it directly enters into the internal logic circuit of the camera, it will cause false triggering, so the input trigger signal should be debounced. In addition, the effective pulse width of the trigger signal input by the user should be greater than the Debouncer Time, otherwise, the trigger signal will be ignored; When Isolated input, GPIO0 or GPIO1 is chosen in the Line Select combo box and GPIO0 or GPIO1 is configured as Input in the GPIO Mode combo box, the Debouncer Time will be enabled for the user to input the Debounter Time between 0 to 20000us; 

3. Application

Pages	Items	Descriptions
IO Control	Input Activation	When Isolated input, GPIO0 or GPIO1 is chosen in the Line Select combo box and GPIO0 or GPIO1 is configured as Input in the GPIO Mode combo box; The Input Activation combo box will be enabled to configure the Input Activation as either Rising Edge or Falling Edge; Also can be configure as high level or low level. When high level is selectd, the camera keeps triggering the frame when the input signal is high; When low level is selectd, the camera keeps triggering the frame when the input signal is low; 
	Trigger Delay	When Isolated input, GPIO0 or GPIO1 is chosen in the Line Select combo box and GPIO0 or GPIO1 is configured as Input in the GPIO Mode combo box, the Trigger Delay will be enabled for the user to input the Trigger Delay time between 0 to 5000000us; If the Trigger Delay time is set to 1000000us, the camera will wait for 1s to capture the image after receiving the trigger signal;
	Output Mode Frame Trigger Wa Exposure Active Strobe User Output Counter Output Timer Output	When Isolated output, GPIO0 or GPIO1 is selected in the Line Select combo box and GPIO0 or GPIO1 is configured as Output in the GPIO Mode combo box, the Output Mode will be enabled. It can be Frame Trigger Wait, Exposure Active, Strobe, User Output, Counter Output or Timer Output. The chosen mode can be used for diversified applications;
		The Frame Trigger Wait signal is pulled low at the start of exposure and pulled high when the last frame of data is read out. The trigger signal input by the user should be in the valid period. If the user inputs a trigger signal when the signal is low, the trigger signal input at this time will be ignored. The following example is the case when Burst Count = 2, as shown below; 
		Exposure Active: when this signal is high, it means the sensor is exposing. This signal can be used to control an external mobile device to remain stationary or move at low speed while the camera is at exposure. The timing diagram of the exposure valid signal is shown below;  When the relative position of the camera and the object to be photographed changes, you can refer to Exposure Active signal to prevent the captured image from being affected by movement and focus adjustment during the exposure process;
		When Strobe is chosen, Strobe Delay Mode, Strobe Delay Time, Strobe Duration will be enabled;
		When User Output is chosen, User Value will be enabled. lines3, line2, line1 are the combination of GPIO1, GPIO0 and Isolated output respectively. If User Value is 001, then line GPIO1 and GPIO0 will be disabled and Isolated output will be enabled; 

3. Application

Pages	Items	Descriptions
IO Control	Output Mode	When the Counter Output is selectd, when the counter value is “m”, the camera triggers “m” times to output a signal.
		When the Timer Output is selectd, the camera keeps output signals. When the Strobe Delay Time is delay, the pulse width of the high level is determined by the Strobe Duration. The pulse width of low level is determined by the Strobe Delay Time.
	Output Inverter	When Isolated output, GPIO0 or GPIO1 is selected in the Line Select combo box and Output is chosen for GPIO0 or GPIO1 in the GPIO Mode combo box, the Output Inverter will be enabled to configure the current selected line’s output as either inverted or not(Yes or No).
	Strobe Delay Mode	When the Timer Output is selectd, the camera keeps output signals. When the Strobe Delay Time is delay, the pulse width of the high level is determined by the Strobe Duration. The pulse width of low level is determined by the Strobe Delay Time.
	Strobe Delay Time	When exposure starts, the strobe does not take effect immediately, and the output is delayed according to the value set by Strobe Delay Time which is between 0 to 5000000us. The Strobe Delay Mode can be pre-delay or delay; It is described below; pre-delay:  delay: 
	Strobe Duration	The high level duration of the strobe is determined by the Strobe Duration which is between 0 to 5000000us as shown below; 
	User Value	Users can input a value at User Value edit box with spin to control the line as disable or enable. Enabled when User Output is chosen in the Output Mode combo box. The logical value 0 or 1’s combination of GPIO1(line3), GPIO0(line2) and Isolated output(line1); When the output mode is selected as User Output, the user can input a value at User Value edit box to control the corresponding line output with 0 or 1; The value here is only valid for the lower three bits of a binary. For example, when line 1 and line 3 are set to User Output mode, and its User Value is set to 4 ('b100), then line 3 outputs 1, and line 1 outputs 0, as shown below. 
	Counter Source	When Counter is chosen in the Trigger Source combo box in the Capture & Resolution group, the Counter Source can be chosen from Isolated input, GPIO0 or GPIO1 in this combo box on the Option>IO Control page;
	Counter Value	The Counter Value is used to divide the frequency of the external input trigger signal when the Counter Trigger Source is chosen in the Capture & Resolution group; See counter descriptions in the 'Trigger Sources and Their Capture Style' table for details;

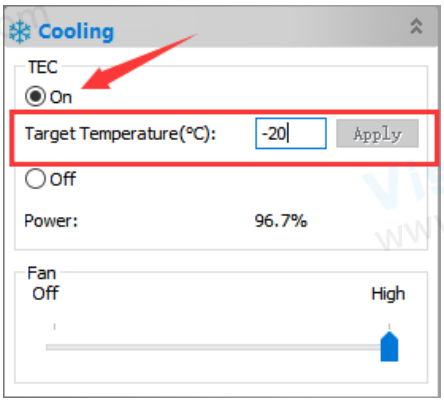
3. Application

Pages	Items	Descriptions
IO Control	Counter Reset	Click Reset button can clear the current counting process and begin a new one;
	PWM Source	When PWM is chosen in the Trigger Source combo box in the Capture & Resolution group, the PWM Source can be from Isolated input, GPIO0, or GPIO1 in this combo box et al. ;
Advanced	Always enable software trigger	When this button is checked, no matter whether Trigger Source is Software or Hardware, the software trigger buttons(Single, Loop, Multiple) are always enabled; If the Plan or Hardware is chosen in the Type combo box on the Options>Sequence page, the Multiple button will switch to Sequence button; The Sequence button will be enabled if a)the Software Trigger Source is chosen in the Capture & Resolution group or b) the Always enable software trigger checkbox is checked on the Options>Advanced property page, in this case, both the Plan and Hardware Sequence captures are supported;
	UART	There is a serial port function on the Advanced page, which can be used to communicate with external devices via serial port. Check Enable to enable this function. When enabled, GPIO0 and GPIO1 can only be used as UART transfers; The Baud Rate supports 9600-115200. Cable Select can configure GPIO0 and GPIO1, which can be configured as TX or RX respectively. Setting a value at TX, clicking Send to send the set value out; click Accept at RX to receive the value from the external device;
	Shutter Mode	Enabled if the camera supports. Users can select Rolling Shutter or Global Reset;
	Exposure Active Mode	Enabled if the camera supports. Users can select Specified lines or Common exposure time;
	Exposure Start Line	Enabled when Specified lines in the Exposure Active Mode combo box is selected. To configure when the Exposure Active signal is valid;
	Exposure End Line	Enabled when Specified lines in the Exposure Active Mode combo box is selected. To configure when the Exposure Active signal is invalid;

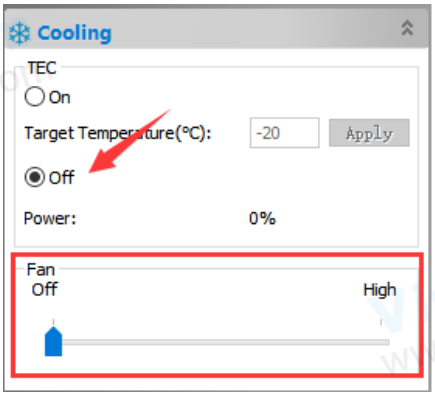
3. Application

3.4 Cooling

There is a Cooling group on the left sidebar in IBoostX. To enable the Cooling function, an external 12V power supply is required. By default, the TEC is turned on. One can set the Target Temperature. After entering the value, click "Apply", and the sensor temperature will gradually approach to the Target Temperature. At the same time, IBoostX can display the current temperature in real time. And the cooling effect can reach about 10-25 degrees lower than the ambient temperature, as shown in the following figure.



The Fan has two gears from Off to High. When High, the Fan speed reaches the highest. When Off, the Fan is turned off, the TEC is also turned off, and the power is 0, as shown in the following figure.



When the TEC is turned on, the Fan will automatically turn on preventing the abnormal situation such as the housing temperature is too high if the Fan stops running when the TEC is working; when the Fan is turned off, the TEC will automatically turn off.

3. Application

3.5 Software development instructions

3.5.1 Introduction to SDK content

Cameras support a variety of APIs, including: Native C/C++,.NET/C#/VB.NET, Python, Java,DirectShow, Twain, LabView, Matlab, etc. Compared with other APIs, Native C/C++ API as a low-level API is characterized by using pure C/C++ development without relying on other runtime libraries. The interface is simple and the control is flexible. This SDK zip package contains all the resources and information needed. The directory is as follows:

- Inc:
  vtibxcam.h, C/C++ header file.
- win: Microsoft Windows platform file
  dotnet: vtibxcam.cs, supports C#. vtibxcam.cs uses P/Invoke to call vtibxcam.dll. Please copy vtibxcam.cs to your C# project for use.
  vtibxcam.vb, supports VB.NET. vtibxcam.vb uses P/Invoke to call vtibxcam.dll. Please copy vtibxcam.vb to your VB.NET project for use.
- x86:
  vtibxcam.lib, x86 lib file.
  vtibxcam.dll, x86 dynamic library file.
  democpp.exe, x86 C++ demo execute the procedure.
- x64:
  vtibxcam.lib, x64 lib file.
  vtibxcam.dll, x64 dynamic library file.
  democpp.exe, x64 C++ demo execute the procedure.
- arm:
  vtibxcam.lib, arm lib file.
  vtibxcam.dll, arm dynamic library file.
- arm64:
  vtibxcam.lib, arm64 lib file.
  vtibxcam.dll, arm64 dynamic library file.
- winrt:
  They can be applied for Dynamic library files of WinRT/ UWP (Universal Windows Platform)/Windows Store App. They are compatible with Windows Runtime and can be referenced by Universal Windows Platform apps. If you use C# to develop UWP, you can use the vtibxcam.cs wrapper class.

  Please pay attention to the Device Capability of uwp. Refer to how to add USB device capabilities to the app manifest. (Microsoft seems to limit the Device entry under DeviceCapability to no more than 100) demouwp.zip is a simple example of uwp. Please modify vid and pid. under DeviceCapability in the file Package.appxmanifest before compiling the run example.
- drivers: (Cameras produced after 2017.1.1 support WinUSB, and drivers no longer need to be installed on Windows 8 and above)
  The x86 folder contains the x86 kernel-mode driver files, including vtibxcam.cat, vtibxcam.inf and vtibxcam.sys.
  The x64 folder contains the x64 kernel-mode driver files, including vtibxcam.cat, vtibxcam.inf and vtibxcam.sys.

3. Application

- samples:

1.democpp, C++ example. This example demonstrates enumerating devices, opening devices, previewing videos, capturing images, setting resolution, triggering, saving images to files in various image formats (.bmp,.jpg,.png, etc.), wmv format video recording, Trigger Mode Trigger Mode, IO control and so on. This example uses the Pull Mode mechanism. To keep the code clean, the WTL library used by the examples can be downloaded from this link http://sourceforge.net/projects/wtl/.

2.demopush, C++ example, using the Push Mode mechanism, StartPushModeV3.

3.demomfc, a simple C++ example, uses MFC as a GUI library, supports opening devices, previewing videos, capturing images, setting resolution, saving images to files in various image formats (.bmp,.jpg,.png, etc.), etc. This example uses the Pull Mode mechanism.

4.demowinformcs1, take C# winform for example, it supports opening devices, previewing videos, capturing images, saving images to files, and setting white balance. This example uses the Pull Mode mechanism, StartPullModeWithWndMsg.

5.demowinformcs2, take C# winform for example, it supports opening devices, previewing videos, capturing images, saving images to files, and setting white balance. This example uses the Pull Mode mechanism, StartPullModeWithCallback.

6.demowinformcs3, take C# winform for example, it supports opening devices, previewing videos, capturing images, saving images to files, and setting white balance. This example uses the Push Mode mechanism, StartPushMode.

7.demowinformvb, take VB.NET winform for example, it supports opening devices, previewing videos, capturing images, saving images to files, and setting white balance. This example uses the Pull Mode mechanism.

- linux: Linux platform files

  Udev: 99-vtibxcam.rules, udev rule file.

  Please refer to: http://reactivated.net/writing_udev_rules.html;
- c#: vtibxcam.cs, Support. Net Core C#. vtibxcam.cs uses P/Invoke to call libvtibxcam.so. Please copy vtibxcam.cs to your C# project for use.
- x86: libvtibxcam.so, x86 version so file.
- x64: libvtibxcam.so, x64 version so file.
- armel: libvtibxcam.so, armel version so file, toolchain is arm-linux-gnueabi.
- armhf: libvtibxcam.so, armhf version so file, toolchain is arm-linux-gnueabihf.
- arm64: libvtibxcam.so, arm64 version so file, toolchain is aarch64-linux-gnu.
- android: libvtibxcam.so for four architectures of Android platform arm, arm64, x86, x64.
- mac: macOS platform files.
- python: vtibxcam.py and example code.
- java: vtibxcam.java and example code (console and Swing).
- doc: SDK usage documentation, Simplified Chinese, English.
- sample:

  de emosimplest, the simplest example, is about 60 lines of code.

  demoraw, RAW data and still shots, about 120 lines of code.

3.5.2 Third Party Interface Software

- directshow: DirectShow SDK and demo program.
- twain: TWAIN SDK.
- labview: Labview SDK and demo program.
- matlab: MatLab demo program.