2024

EHD MaxCam 16bit Series Cooled Cameras Manual

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1.1 MaxCam Series TE-Cooling USB3.0 CMOS Camera

1.1.1 The Basic Characteristic of the 16 Bit MaxCam Series

MaxCam series camera adopts SONY Exmor or GSENSE with big pixel size or full-frame CMOS sensor as the image-picking device and USB3.0 is used as the transfer interface to increase the frame rate.

With the two-stage peltier cooling sensor chip to -40°C below ambient temperature. This will greatly increase the signal to noise ratio and decrease the image noise. Smart structure is designed to assure the heat radiation efficiency and avoid the moisture problem. Electric fan is used to increase the heat radiation speed.

MaxCam series comes with advanced video & image processing application ToupView/ToupLite; Providing Windows/Linux/ OSX multiple platform SDK; Native C/C++, C#/VB.NET, DirectShow, Twain Control API;

The MaxCam series can be widely used in low light environment and microscope fluorescence image capture and analysis, as well as the astronomy deep sky application.

MaxCam Series (Square Housing)

The basic characteristic of MaxCam series can be summarized as follows:

- Standard camera with SONY Exmor or GSENSE CMOS sensors;
- 8 Bit /16 Bit switchable
- Big pixels or full-frame sensor size;
- Two-stage TE-cooling with controllable electric fan;
- Sensor chip cooling up to-40°C below ambient temperature;
- Working temperature can be regulated to specified temperature in 5 minutes;
- Smart structure to assure the heat radiation efficiency and avoid the moisture problem;
- IR-CUT/AR coated windows (Optional);
- M42, M52 x 0.75 or C-mount (depends on sensor and camera model)
- USB3.0 5Gbit/second interface ensuring high speed data transmission;
- Up to 1000 seconds long time exposure;
- Embedded up to 16bit hardware ISP module;
- Including 2-D denoising and sharpening
- Ultra-Fine color engine with perfect color reproduction capability;
- Support the capture of video and image in software / hardware trigger mode
- With advanced video & image processing application EHDView/EHDLite;
- Support both video and trigger modes;
- Providing Windows/Linux/Mac OS multiple platforms SDK;
- Native C/C++, C#/VB.NET, DirectShow, Twain control API;

2 MaxCam Series Camera

Specification(18) 2.1 MaxCam-811M-TE

Table 2-1 MaxCam-811M-TE camera specifications

Model / Parameter	MAX251AM-U3	MAX251AM-10G
	251M pixels 4.1" CMOS USB3.0 / 10GigE industrial camera	
Camera		
Data interface	USB3.0	10GigE
Sensor model	Sony IMX811ALR	
Pixel size	2.81 μm x 2.81 μm	
Sensor size	4.1"	
Frame rate	1.5fps@19200 x 12800	
Conversion Gain	TBD	
Readout Noise	TBD	
Full Well	TBD	
Dynamic range	TBD	
SNRmax	TBD	
Sensitivity	TBD	
Dark current	TBD	
Gain range	1x-50x	
Exposure time	15μs-3600sec	
Shutter	Rolling shutter	
Binning	Software2x2, 3x3, 4x4	
Digital I/O	One optical-coupling isolated input, one optical-coupling isolated output, two non-isolated input and output	
Data Format	8bit / 12bit	
General specification		
Power supply	Power with USB3.0 or 19V Power adapter	19V Power adapter
Power consumption	TBD	TBD
Temperature	Working temperature -10~50℃, storage temperature -30~70℃	
Humidity	20%-80%, no condensation	
Size	110mm×110mm×123.8mm	110mm x 110mm x 129.8mm
Weight	1.44kg	
Lens mount	M72-mount	
Software	EHDView/ SDK	
Platform and architecture	Win32/WinRT/Linux/macOS/Android；X86/X64/armhf/armel/arm64	
Certification	CE, FCC	

2.2 MaxCam-811C-TE

Table 2-2 MaxCam-811C-TR camera specifications

Model / Parameter	MAX251AC-U3	MAX251AC-10G
	251M pixels 4.1" CMOS USB3.0 / 10GigE industrial camera	
Camera		
Data interface	USB3.0	10GigE
Sensor model	Sony IMX811AQR	
Pixel size	2.81 μm x 2.81 μm	
Sensor size	4.1"	
Frame rate	1.5fps@19200 x 12800	
Conversion Gain	TBD	
Readout Noise	TBD	
Full Well	TBD	
Dynamic range	TBD	
SNRmax	TBD	
Sensitivity	TBD	
Dark current	TBD	
Gain range	1x-50x	
Exposure time	15μs-3600sec	
Shutter	Rolling shutter	
Binning	Software2x2, 3x3, 4x4	
Digital I/O	One optical-coupling isolated input, one optical-coupling isolated output, two non-isolated input and output	
Data Format	8bit / 12bit	
General specification		
Power supply	Power with USB3.0 or 19V Power adapter	19V Power adapter
Power consumption	TBD	TBD
Temperature	Working temperature -10~50℃, storage temperature -30~70℃	
Humidity	20%-80%, no condensation	
Size	110mm x 110mm x 123.8mm	110mm x 110mm x 129.8mm
Weight	1.44kg	
Lens mount	M72-mount	
Software	EHDView/ SDK	
Platform and architecture	Win32/WinRT/Linux/macOS/Android；X86/X64/armhf/armel/arm64	
Certification	CE, FCC	

2.3 MaxCam-411M-TE

Table 2-3 MaxCam-411M-TE camera specifications

Parameter \ Model	MAX151AM-U3	MAX151AM-10G
	151M pixels 4.2" CMOS USB3.0 / 10GigE industrial camera	
Camera		
Data interface	USB3.0	10GigE
Sensor model	Sony IMX411ALR	
Pixel size	3.76 μm x 3.76 μm	
Sensor size	4.2"	
Frame rate	2.4@14176x10640 6.9@7072x5320 20.8@4704x3546 61.9@1568x1178	6.1@14176x10640 6.9@7072x5320 20.8@4704x3546 61.9@1568x1178
Conversion Gain	0.78e/ADU	
Readout Noise	2.8e	
Full Well	50873.9e	
Dynamic range	84.9dB	
SNRmax	47dB	
Sensitivity	871mV with 1/30s	
Dark current	0.04mV with 1/30s	
Gain range	1x-50x	
Exposure time	15μs-3600sec	
Shutter	Rolling shutter	
Binning	Software2x2, 3x3, 4x4	
Digital I/O	One optical-coupling isolated input, one optical-coupling isolated output, two non-isolated input and output	
Data Format	8bit / 12bit	
General specification		
Power supply	Power with USB3.0 or 19V Power adapter	19V Power adapter
Power consumption	TBD	TBD
Temperature	Working temperature -10~50℃, storage temperature -30~70℃	
Humidity	20%-80%, no condensation	
Size	110mm x 110mm x 123.8mm	110mm x 110mm x 129.8mm
Weight	1.44kg	
Lens mount	M72 mount	
Software	EHDView/ SDK	
Platform and architecture	Win32/WinRT/Linux/macOS/Android；X86/X64/armhf/armel/arm64	
Certification	CE, FCC	

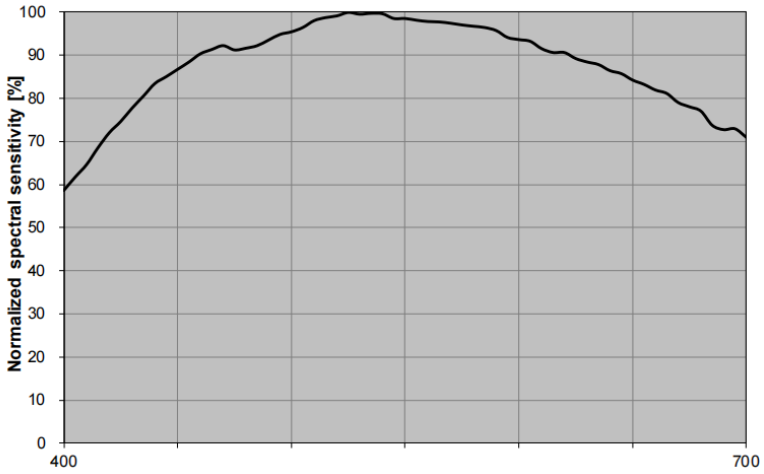


Figure 2-1 MaxCam-411M-TE spectral response curve

2.4 MaxCam-411C-TE

Table 2-4 MaxCam-411C-TE camera specifications

Model / Parameter	MAX151AC-U3	MAX151AC-10G
	151M pixels 4.2" CMOS USB3.0 / 10GigE industrial camera	
Camera		
Data interface	USB3.0	10GigE
Sensor model	Sony IMX411AQR	
Pixel size	3.76 μm x 3.76 μm	
Sensor size	4.2"	
Frame rate	2.4@14176x10640 6.9@7072x5320 20.8@4704x3546 61.9@1568x1178	6.1@14176x10640 6.9@7072x5320 20.8@4704x3546 61.9@1568x1178
Conversion Gain	0.78e/ADU	
Readout Noise	2.8e	
Full Well	50873.9e	
Dynamic range	84.9dB	
SNRmax	47dB	
Sensitivity	485mV with 1/30s	
Dark current	0.04mV with 1/30s	
Gain range	1x-50x	
Exposure time	15μs-3600sec	
Shutter	Rolling shutter	
Binning	Software2x2, 3x3, 4x4	
Digital I/O	One optical-coupling isolated input, one optical-coupling isolated output, two non-isolated input and output	
Data Format	8bit / 12bit	
General specification		
Power supply	Power with USB3.0 or 19V Power adapter	19V Power adapter
Power consumption	TBD	TBD
Temperature	Working temperature -10~50℃, storage temperature -30~70℃	
Humidity	20%-80%, no condensation	
Size	110mm x 110mm x 123.8mm	110mm x 110mm x 129.8mm
Weight	1.44kg	
Lens mount	M72 mount	
Software	EHDView/ SDK	
Platform and architecture	Win32/WinRT/Linux/macOS/Android；X86/X64/armhf/armel/arm64	
Certification	CE, FCC	

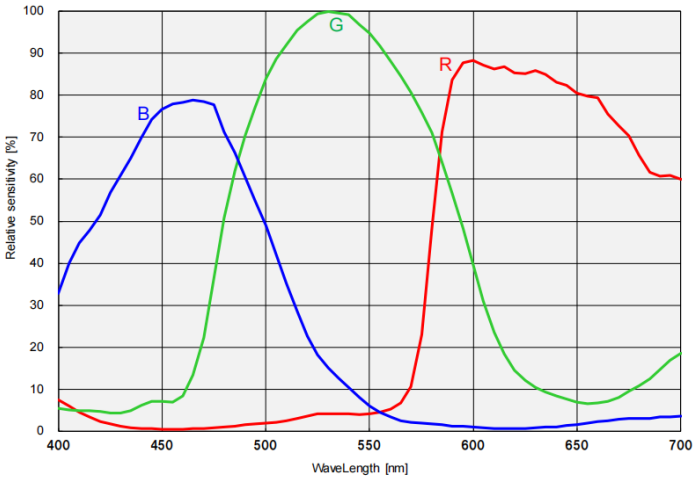


Figure 2-2 MaxCam-411C-TE spectral response curve

2.5 MaxCam-461M-TE

Table 2-5 MaxCam-461M-TE camera specifications

Model / Parameter	MAX102AM-U3	MAX102AM-10G
	102M pixels 3.4" CMOS USB3.0 / 10GigE industrial camera	
Camera		
Data interface	USB3.0	10GigE
Sensor model	Sony IMX461ALR	
Pixel size	3.76 μm x 3.76 μm	
Sensor size	3.4"	
Frame rate	3.5@11648x8742 8.7@5824x4370 27.8@3872x2912 82.5@1280x970	8.7@11648x8742 8.7@5824x4370 27.8@3872x2912 82.5@1280x970
Conversion Gain	0.75e/ADU	
Readout Noise	3.57e	
Full Well	49.09ke	
Dynamic range	82.8dB	
SNRmax	46.9dB	
Sensitivity	871mV with 1/30s	
Dark current	0.04mV with 1/30s	
Gain range	1x-50x	
Exposure time	15μs-3600sec	
Shutter	Rolling shutter	
Binning	Software2x2, 3x3, 4x4	
Digital I/O	One optical-coupling isolated input, one optical-coupling isolated output, two non-isolated input and output	
Data Format	8bit / 12bit	
General specification		
Power supply	Power with USB3.0 or 19V Power adapter	19V Power adapter
Power consumption	Cooled 58.86W / Uncooled 14.95W	TBD
Temperature	Working temperature -10~50℃, storage temperature -30~70℃	
Humidity	20%-80%, no condensation	
Size	110mm x 110mm x 123.8mm	110mm x 110mm x 129.8mm
Weight	1.44kg	
Lens mount	M72 mount	
Software	EHDView/ SDK	
Platform and architecture	Win32/WinRT/Linux/macOS/Android；X86/X64/armhf/armel/arm64	
Certification	CE, FCC	

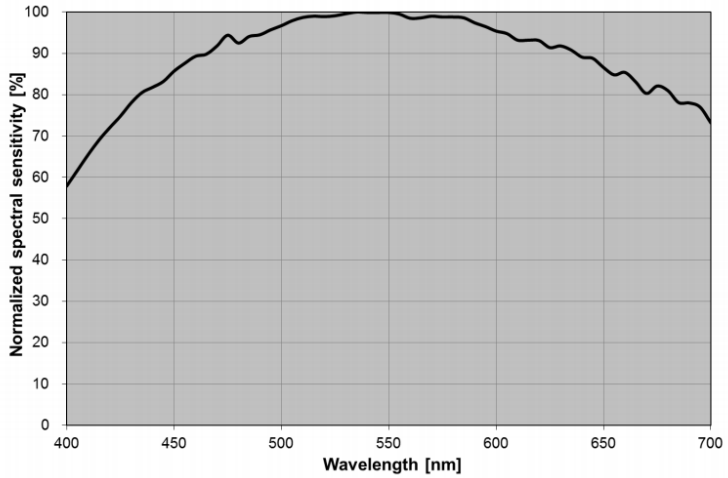


Figure 2-3 MaxCam-461M-TE spectral response curve

2.6 MaxCam-461C-TE

Table 2-6 MaxCam-461C-TE camera specifications

Model / Parameter	MAX102AC-U3	MAX102AC-10G
	102M pixels 3.4" CMOS USB3.0 / 10GigE industrial camera	
Camera		
Data interface	USB3.0	10GigE
Sensor model	Sony IMX461AQR	
Pixel size	3.76 μm x 3.76 μm	
Sensor size	3.4"	
Frame rate	3.5@11648x8742 8.7@5824x4370 27.8@3872x2912 82.5@1280x970	8.7@11648x8742 8.7@5824x4370 27.8@3872x2912 82.5@1280x970
Conversion Gain	0.75e/ADU	
Readout Noise	3.57e	
Full Well	49.09ke	
Dynamic range	82.8dB	
SNRmax	46.9dB	
Sensitivity	485mV with 1/30s	
Dark current	0.04mV with 1/30s	
Gain range	1x-50x	
Exposure time	15μs-3600sec	
Shutter	Rolling shutter	
Binning	Software2x2, 3x3, 4x4	
Digital I/O	One optical-coupling isolated input, one optical-coupling isolated output, two non-isolated input and output	
Data Format	8bit / 12bit	
General specification		
Power supply	Power with USB3.0 or 19V Power adapter	19V Power adapter
Power consumption	Cooled 58.86W / Uncooled 14.95W	TBD
Temperature	Working temperature -10~50℃, storage temperature -30~70℃	
Humidity	20%-80%, no condensation	
Size	110mm x 110mm x 123.8mm	110mm x 110mm x 129.8mm
Weight	1.44kg	
Lens mount	M72 mount	
Software	EHDView/ SDK	
Platform and architecture	Win32/WinRT/Linux/macOS/Android；X86/X64/armhf/armel/arm64	
Certification	CE, FCC	

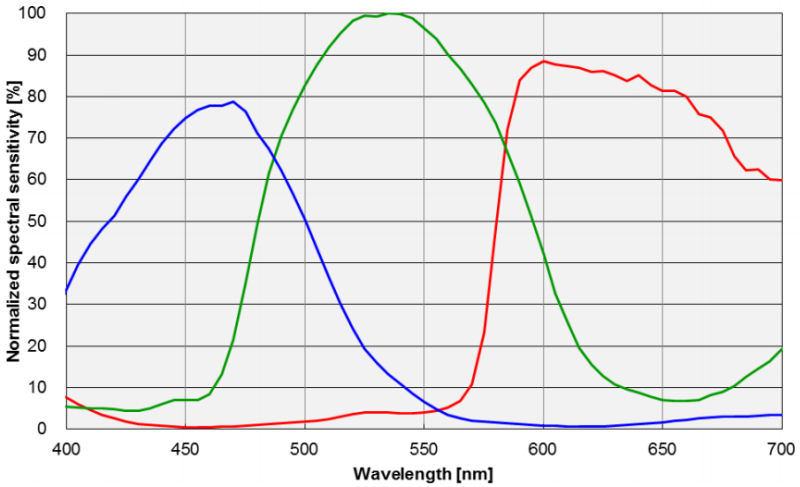


Figure 2-4 MaxCam-461C-TE spectral response curve

2.7 MaxCam-455M-TE

Table 2-7 MaxCam-455M-TE camera specifications

Model / Parameter	MAX62AM
	61M pixels 2.7" CMOS USB3.0 industrial camera
Camera	
Sensor model	Sony IMX455ALK
Pixel size	3.76 μm x 3.76 μm
Sensor size	2.7"
Frame rate	6.1@9568x6380(16bit) 19.1@4784x3190 55.6@3184x2124 191@1040x706
Conversion Gain	0.79e-(HCG) 1.62e-(LCG)
Readout Noise	3.51e-(HCG) 5.39e-(LCG)
Full Well	51550.45e-(HCG) 87353.34e-(LCG)
Dynamic range	83.34dB (HCG) 84.18dB (LCG)
SNRmax	47.12dB(HCG) 49.41dB(LCG)
Sensitivity	871mV with 1/30s
Dark current	0.04mV with 1/30s
Gain range	1x-50x
Exposure time	100μs-1000sec
Shutter	Rolling shutter
Binning	Software2x2, 3x3, 4x4
Data interface	USB3.0（USB3.1 GEN1）
Digital I/O	One optical-coupling isolated input, one optical-coupling isolated output, two non-isolated input and output
Data Format	8bit / 16bit
General specification	
Power supply	Power with USB3.0 or 19V Power adapter
Power consumption	TBD
Temperature	Working temperature -10~50℃, storage temperature -30~70℃
Humidity	20%-80%, no condensation
Size	110mm×110mm×121.5mm
Weight	1.7kg
Lens mount	M52 mount
Software	EHDView/ SDK
Platform and architecture	Win32/WinRT/Linux/macOS/Android；X86/X64/armhf/armel/arm64
Certification	CE, FCC

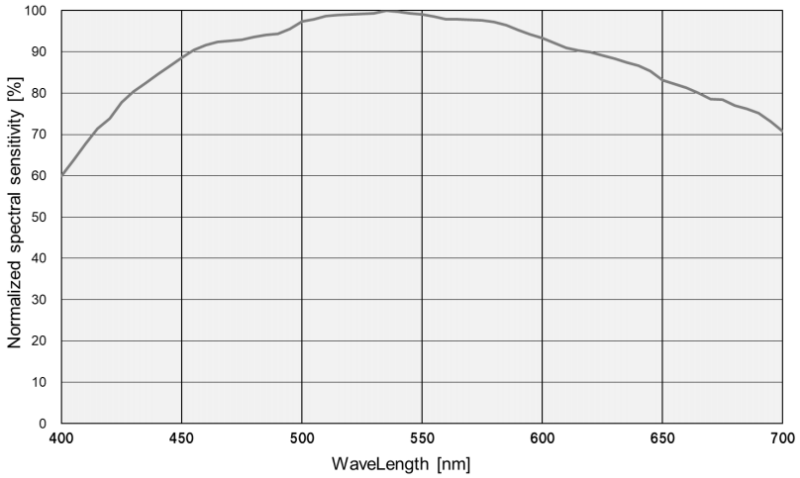


Figure 2-5 MaxCam-455M-TE spectral response curve

2.8 MaxCam-455C-TE

Table 2-8 MaxCam-455C-TE camera specifications

Model / Parameter	MAX62AC 61M pixels 2.7" CMOS USB3.0 industrial camera
Camera	
Sensor model	Sony IMX455AQK
Pixel size	3.76 μm x 3.76 μm
Sensor size	2.7"
Frame rate	6.1@9568x6380(16bit) 19.1@4784x3190 55.6@3184x2124 191@1040x706
Conversion Gain	0.79e-(HCG) 1.62e-(LCG)
Readout Noise	3.51e-(HCG) 5.39e-(LCG)
Full Well	51550.45e-(HCG) 87353.34e-(LCG)
Dynamic range	83.34dB (HCG) 84.18dB (LCG)
SNRmax	47.12dB(HCG) 49.41dB(LCG)
Sensitivity	485mV with 1/30s
Dark current	0.04mV with 1/30s
Gain range	1x-50x
Exposure time	100μs-1000sec
Shutter	Rolling shutter
Binning	Software2x2, 3x3, 4x4
Data interface	USB3.0（USB3.1 GEN1）
Digital I/O	One optical-coupling isolated input, one optical-coupling isolated output, two non-isolated input and output
Data Format	8bit / 16bit
General specification	
Power supply	Power with USB3.0 or 19V Power adapter
Power consumption	TBD
Temperature	Working temperature -10~50℃, storage temperature -30~70℃
Humidity	20%-80%, no condensation
Size	110mm×110mm×121.5mm
Weight	1.7kg
Lens mount	M52 mount
Software	EHDView/ SDK
Platform and architecture	Win32/WinRT/Linux/macOS/Android；X86/X64/armhf/armel/arm64
Certification	CE, FCC

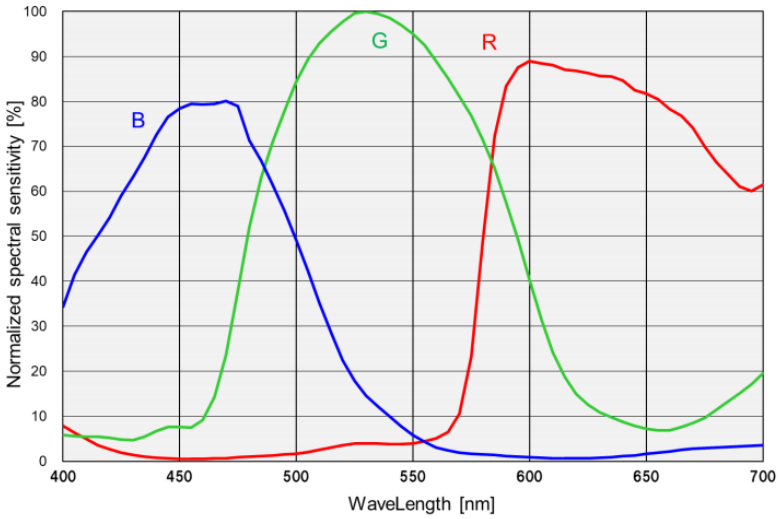


Figure 2-6 MaxCam-455C-TE spectral response curve

2.9 MaxCam-410C-TE

Table 2-9 MaxCam-410C-TE camera specifications

Parameter \ Model	MAX24AC
	24M pixels 2.7" CMOS USB3.0 industrial camera
Camera	
Sensor model	Sony IMX410CQK
Pixel size	5.94 μm x 5.94 μm
Sensor size	2.7"
Frame rate	15.3@6064x4040(14bit) 41@3024x2012 114@2016x1342
Conversion Gain	1.2e-(HCG) 6.19e-(LCG)
Readout Noise	0.58e-(HCG) 4.56e-(LCG)
Full Well	19653.77e-(HCG) 101464.01e-(LCG)
Dynamic range	84dB (HCG) 84dB (LCG)
SNRmax	42.93dB(HCG) 50.06dB(LCG)
Sensitivity	573mV with 1/30s
Dark current	0.04mV with 1/30s
Gain range	1x-50x
Exposure time	100μs-1000sec
Shutter	Rolling shutter
Binning	Software2x2, 3x3, 4x4
Data interface	USB3.0（USB3.1 GEN1）
Digital I/O	One optical-coupling isolated input, one optical-coupling isolated output, two non-isolated input and output
Data Format	8bit / 14bit
General specification	
Power supply	Power with USB3.0 or 19V Power adapter
Power consumption	TBD
Temperature	Working temperature -10~50℃, storage temperature -30~70℃
Humidity	20%-80%, no condensation
Size	110mm×110mm×121.5mm
Weight	1.7kg
Lens mount	M52 mount
Software	EHDView/ SDK
Platform and architecture	Win32/WinRT/Linux/macOS/Android；X86/X64/armhf/armel/arm64
Certification	CE, FCC

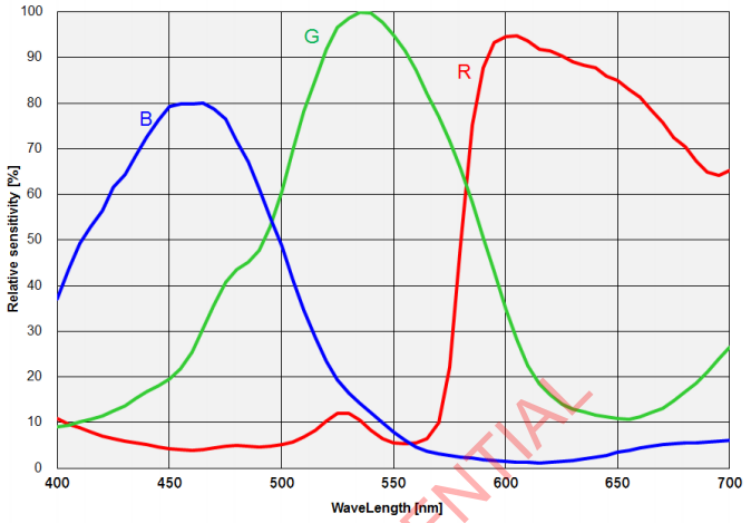


Figure 2-7 MaxCam-410C-TE spectral response curve

2.10 MaxCam-2020Me-TE

Table 2-10 MaxCam-2020Me-TE camera specifications

Parameter \ Model	MAX04AM
	4.2M pixels 1.2" CMOS USB3.0 industrial camera
Camera	
Sensor model	GPixel GSENSE2020e
Pixel size	6.5 μm x 6.5 μm
Sensor size	1.2"
Frame rate	45@2048x2048 45@1024 x 1024
Conversion Gain	1.17(HCG) 3.62(LCG)0.69(HDR)
Readout Noise	2.06e-(HCG) 10.39e-(LCG)3.62e-(HDR)
Full Well	19.17ke-(HCG)59.30ke-(LCG)45.02ke-(HDR)
Dynamic range	66.72dB(HCG) 66.36dB(LCG)81.6dB(HDR)
SNRmax	42.83dB(HCG)47.73dB(LCG)46.53dB(HDR)
Sensitivity	8.1x107 (e-/((W/m2).s))
Peak QE	64.2% @595nm
Dark current	0.12(e-/s/pix) @-10C°
Gain range	1x-50x
Exposure time	100μs-1000sec
Shutter	Rolling shutter
Binning	Software2x2, 3x3, 4x4, hardware2x2
Data interface	USB3.0（USB3.1 GEN1）
Digital I/O	One optical-coupling isolated input, one optical-coupling isolated output, two non-isolated input and output
Data Format	8bit / 16bit
General specification	
Power supply	Power with USB3.0 or 19V Power adapter
Power consumption	Cooled 44.8W / Uncooled 6.65W
Temperature	Working temperature -10~50℃, storage temperature -30~70℃
Humidity	20%-80%, no condensation
Size	110mm×110mm×121.5mm
Weight	1.7kg
Lens mount	C mount
Software	EHDView/ SDK
Platform and architecture	Win32/WinRT/Linux/macOS/Android；X86/X64/armhf/armel/arm64
Certification	CE, FCC

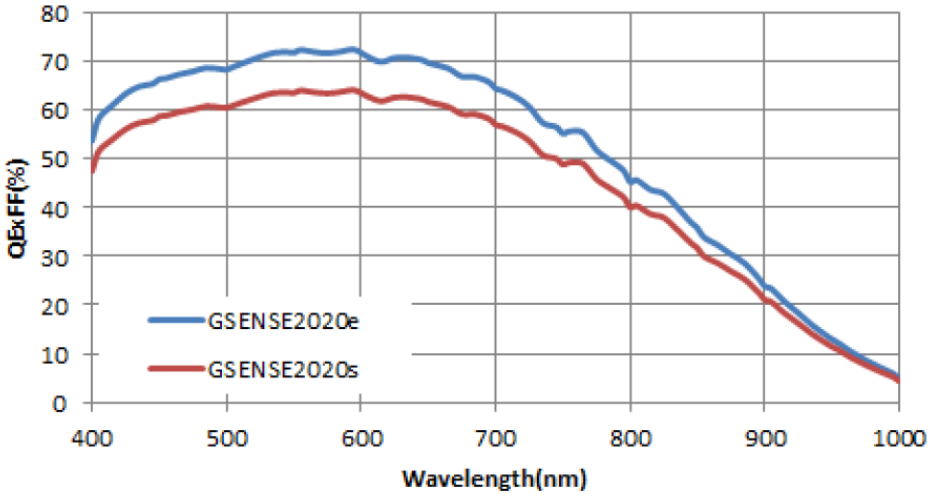


Figure 2-8 MaxCam-2020Me-TE spectral response curve

2.11 MaxCam-2020UV-TE

Table 2-11 MaxCam-2020UV-TE camera specifications

Model / Parameter	MAX04BM 4.2M pixels 1.2" CMOS USB3.0 industrial camera
Camera	
Sensor model	GPixel GSENSE2020BSI
Pixel size	6.5 μm x 6.5 μm
Sensor size	1.2"
Frame rate	45@2048x2048 45@1024 x 1024
Conversion Gain	3.23e-(HCG) 12.42e-(LCG) 0.76e-(HDR)
Readout Noise	6.78e-(HCG) 29.07e-(LCG) 5.33e-(HDR)
Full Well	13210.49e-(HCG) 50873.17e-(LCG) 49863.77e-(HDR)
Dynamic range	65.58dB (HCG) 64.62dB (LCG) 79.14dB (HDR)
SNRmax	41.21dB(HCG) 47.06dB(LCG) 46.98dB(LCG)
Sensitivity	1.1x108 (e-/((W/m2).s))
Peak QE	93.7% @550nm
Dark current	0.15(e-/s/pix) @-15C°
Gain range	1x-50x
Exposure time	100μs-1000sec
Shutter	Rolling shutter
Binning	Software2x2, 3x3, 4x4, hardware2x2
Data interface	USB3.0（USB3.1 GEN1）
Digital I/O	One optical-coupling isolated input, one optical-coupling isolated output, two non-isolated input and output
Data Format	8bit / 16bit
General specification	
Power supply	Power with USB3.0 or 19V Power adapter
Power consumption	Cooled 48.26W / Uncooled 8.17W
Temperature	Working temperature -10~50℃, storage temperature -30~70℃
Humidity	20%-80%, no condensation
Size	110mm×110mm×121.5mm
Weight	1.7kg
Lens mount	C mount
Software	EHDView/ SDK
Platform and architecture	Win32/WinRT/Linux/macOS/Android；X86/X64/armhf/armel/arm64
Certification	CE, FCC

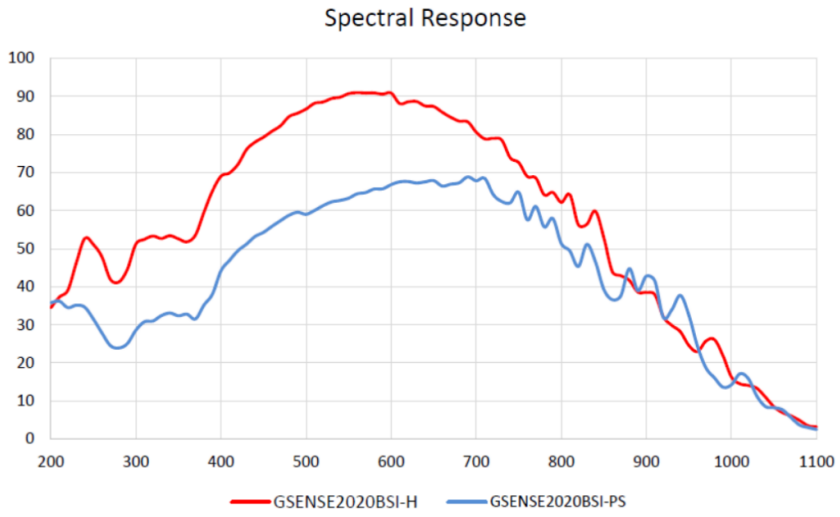


Figure 2-9 MaxCam-2020UV-TE spectral response curve

2.12 MaxCam-400UV-TE

Table 2-12 MaxCam-400UV-TE camera specifications

Model / Parameter	MAX04CM 4.2M pixels 2.0" CMOS USB3.0 industrial camera
Camera	
Sensor model	GPixel GSENSE400BSI
Pixel size	11 μm x 11 μm
Sensor size	2.0"
Frame rate	44@2048x2048 44@1024 x 1024
Conversion Gain	2.46e-(HCG) 19.88e-(LCG) 0.46e-(HDR)
Readout Noise	6.75e-(HCG) 33.37e-(LCG) 5.52e-(HDR)
Full Well	10086.89e-(HCG) 81427.2e-(LCG) 30471.53e-(HDR)
Dynamic range	63.24dB (HCG) 67.5dB (LCG) 74.58dB (HDR)
SNRmax	40.04dB(HCG) 49.11dB(LCG) 44.84dB(LCG)
Sensitivity	3.25x108 (e-/((W/m2).s))
Peak QE	95.3% @560nm
Dark current	1.5(e-/s/pix) @-10C°
Gain range	1x-50x
Exposure time	100μs-1000sec
Shutter	Rolling shutter
Binning	Software2x2, 3x3, 4x4, hardware2x2
Data interface	USB3.0（USB3.1 GEN1）
Digital I/O	One optical-coupling isolated input, one optical-coupling isolated output, two non-isolated input and output
Data Format	8bit / 16bit
General specification	
Power supply	Power with USB3.0 or 19V Power adapter
Power consumption	Cooled 50.2W / Uncooled 7.33W
Temperature	Working temperature -10~50℃, storage temperature -30~70℃
Humidity	20%-80%, no condensation
Size	110mm×110mm×121.5mm
Weight	1.7kg
Lens mount	M42 mount
Software	EHDView/ SDK
Platform and architecture	Win32/WinRT/Linux/macOS/Android；X86/X64/armhf/armel/arm64
Certification	CE, FCC

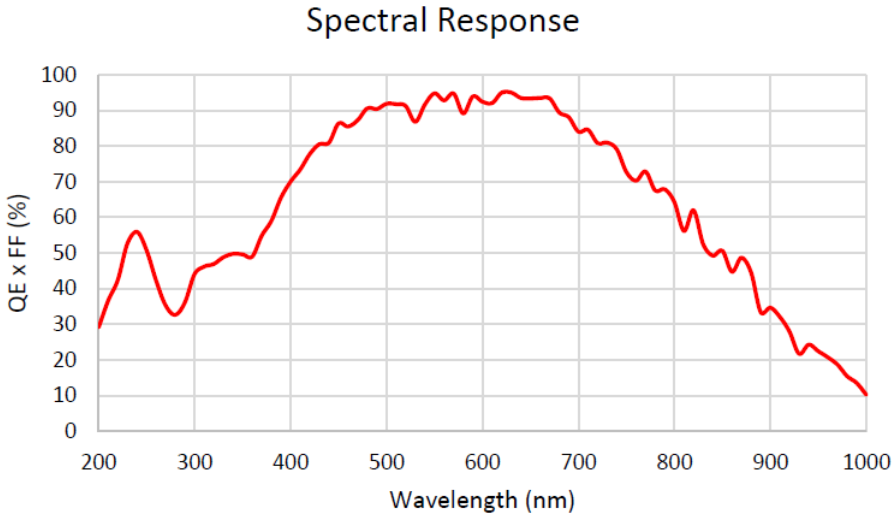


Figure 2-10 MaxCam-400UV-TE spectral response curve

12 Camera Dimension and Interface

12.1 MaxCam Series USB3 Camera

12.1.1 Mechanical Housing Dimensions

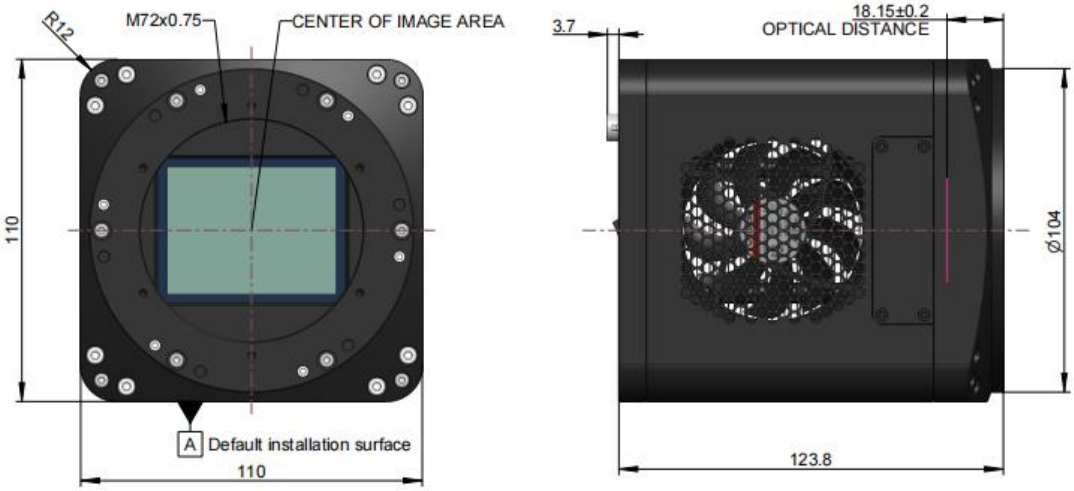


Figure 12-1 MaxCam-811M/C-TE & MaxCam-411M/C-TE dimensions (mm)

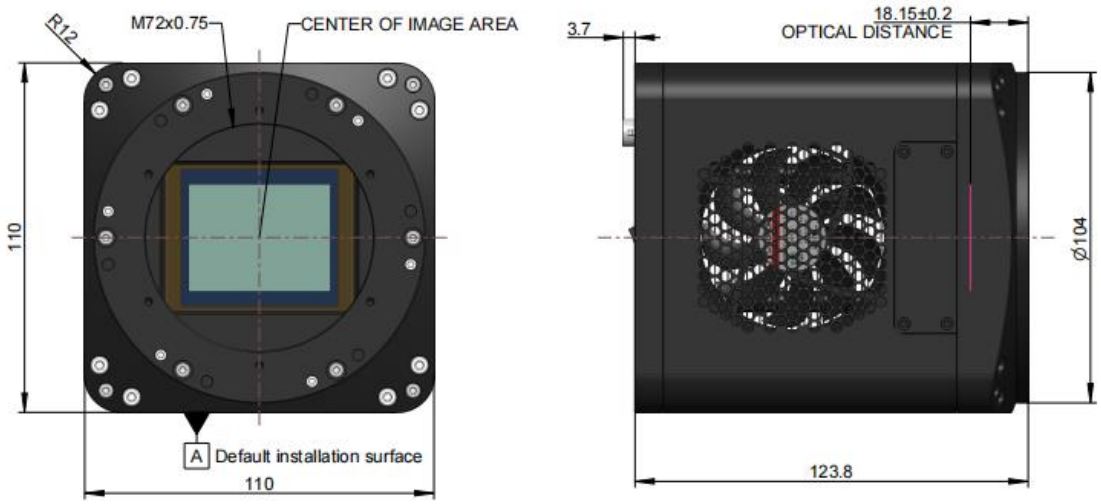


Figure 12-2 MaxCam-461M-TE dimensions (mm)

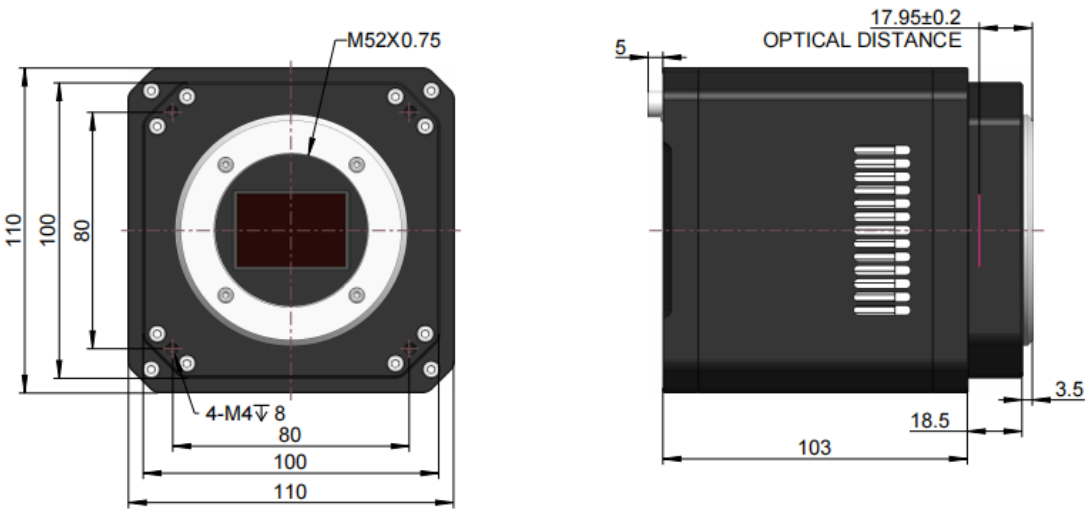


Figure 12-3 MaxCam-455M/C-TE& MaxCam-410C-TR dimensions (mm)

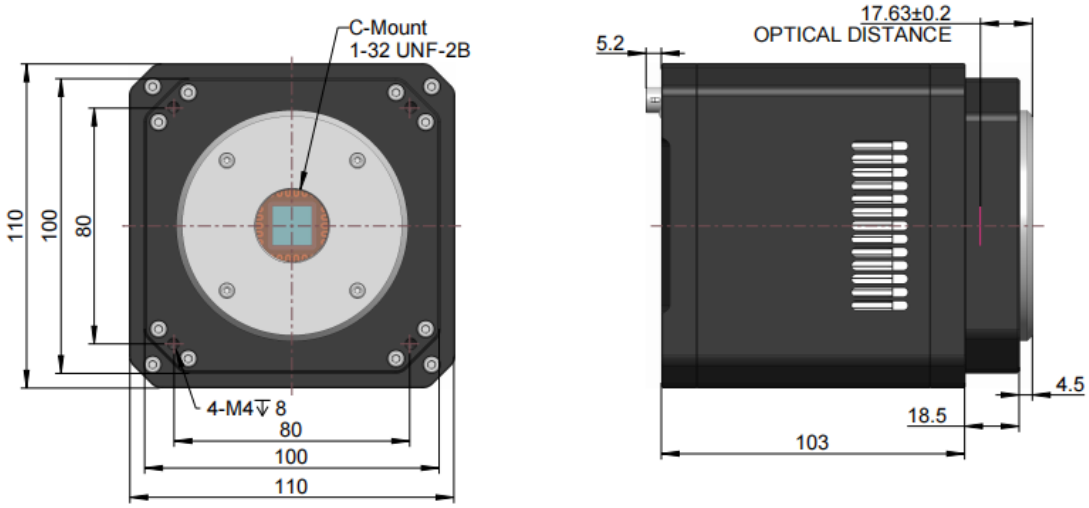


Figure 12-4 MaxCam-2020UV-TE dimensions (mm)

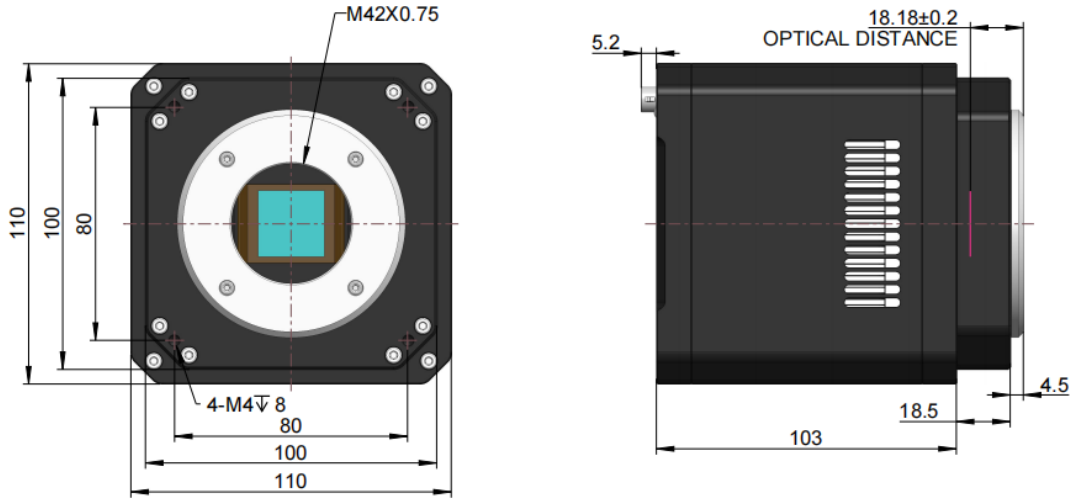


Figure 12-5 MaxCam-400UV-TE dimensions (mm)

12.1.2 Interface Description

Figure 12-6 MaxCam-811, -411, -461 Camera interface diagram

Table 12-1 MaxCam-811, -411, -461 Camera interface definition

Item	Specification
1	DC 19V power port
2	Trigger 7PIN
3	USB 3.0 port
4	Power switch
5	Power LED indicators
6	System LED indicators
7	TEC LED indicators
8	FAN LED indicators

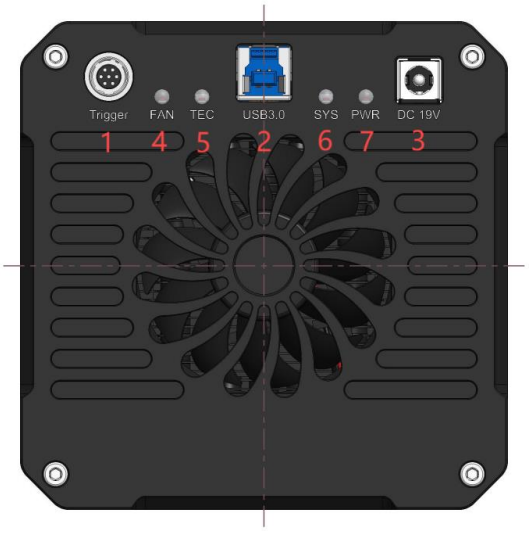


Figure 12-7 MaxCam-455, -410C, -2020 Camera interface diagram

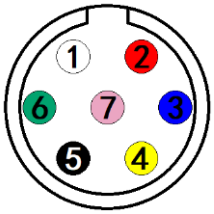
Table 12-2 MaxCam-455, -410C, -2020 interface definition

Item	Specification
1	Trigger 7PIN
2	USB 3.0/ USB 2.0 port
3	DC 19V power port

4	FAN LED indicators
5	TEC LED indicators
6	System LED indicators
7	Power LED indicators

12.1.3 Power Supply and I/O Connector

Table 12-3 MaxCam series pin signal definition



Color	Pin	Signal	Signal description
White	1	GND	Direct-coupled signal ground
Red	2	19V	19VDC power input or output
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)

12.1.4 Packing Information

Table 12-4 Recommended accessories

Order number	Accessories name	Quantity	Instruction
1	Camera	1	Camera referred in this manual
	Power adapter	1	Input: AC 100~240V 50Hz/60Hz,output: DC 19V 4A
2	I/O cable	1	7 Pin cable or extended cable
3	Cable	1	USB3.0 or Micro USB3.0 cable
4	Lens (optional)	1	M72 or M52 or M42 or C-mount lens

12.2 MaxCam Series GigECamera

12.2.1 Mechanical Housing Dimensions

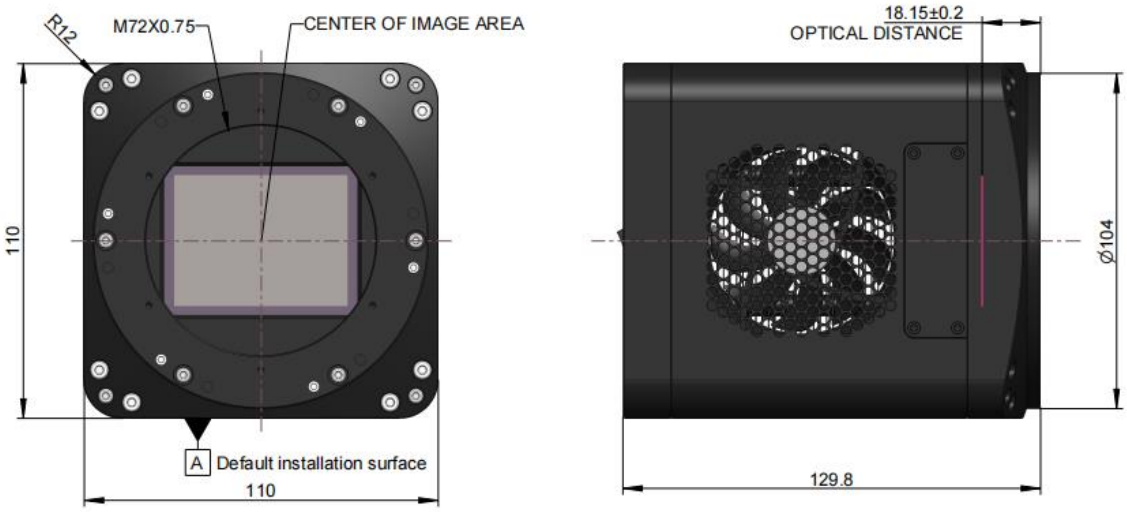


Figure 12-8 MaxCam- 811M/C-TE& MaxCam-411M/C-TE dimensions (mm)

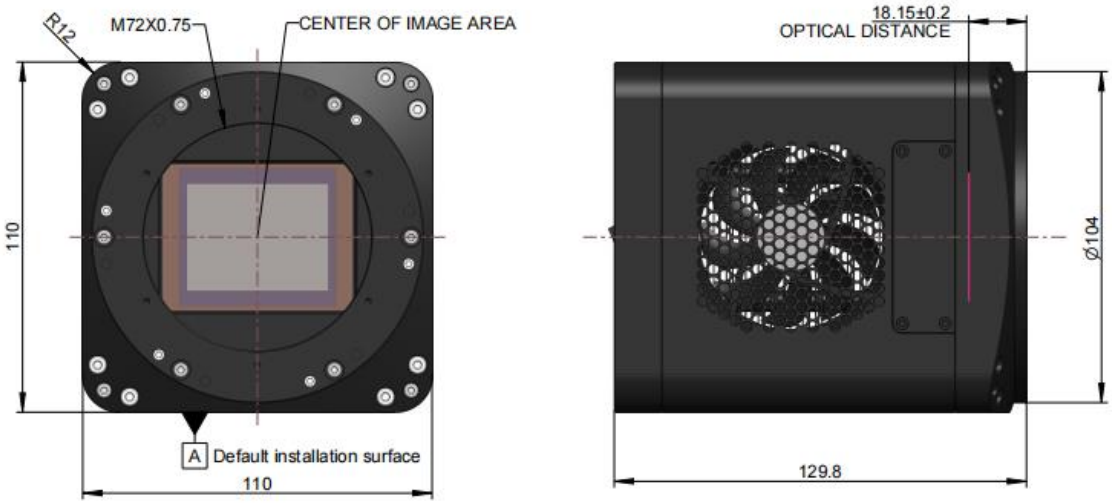


Figure 12-9 MaxCam-461M/C-TE dimensions (mm)

12.2.2 Interface Description

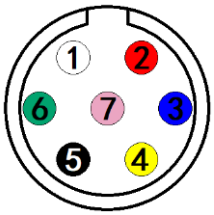
Figure 12-10 MaxCam-811, -411, -461 Camera interface diagram

Table 12-5 MaxCam-811, -411, -461 Camera interface definition

Item	Specification
1	DC 19V power port
2	Trigger 7PIN
3	10GigE port
4	Power switch
5	Power LED indicators
6	System LED indicators
7	TEC LED indicators
8	FAN LED indicators

12.2.3 Power Supply and I/O Connector

Table 12-6 MaxCam series pin signal definition



Color	Pin	Signal	Signal description
White	1	GND	Direct-coupled signal ground
Red	2	19V	19VDC power input or output
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)

12.2.4 Packing Information

Table 12-7 Recommended accessories

Order number	Accessories name	Quantity	Instruction
1	Camera	1	Camera referred in this manual
	Power adapter	1	Input: AC 100~240V 50Hz/60Hz,output: DC 19V 4A
2	I/O cable	1	7 Pin cable or extended cable
3	Cable	1	GigE cable
4	Lens (optional)	1	M72 or M52 or M42 or C-mount lens

14 Description of Functions

14.1 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).

14.2 ROI Control

Partial cameras supports hardware ROI. The smaller the ROI size, the faster the frame rate.

14.3 Bandwidth and Precise Frame Rate Control

14.3.1 Bandwidth

Partial cameras supports bandwidth adjustment from 1% to 100%. As shown in Figure 14-1, the camera is with 100% bandwidth by default, and you can drag the slider to set the desired bandwidth.

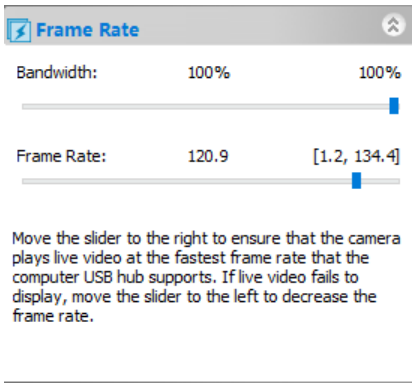


Figure 14-1 Bandwidth and precise frame rate settings

14.3.2 Precise Frame Rate Control

Partial cameras series supports precise frame rate control. The frame rate range will vary based on bandwidth, bit depth, resolution, ROI. As shown in Figure 14-1, the current frame rate can be set by dragging the Bandwith or Frame Rate slider bar left or right.

14.4 DDR3 Buffer

Camera has a built-in 512MB (4Gb) DDR3 buffer, which can effectively improve the stability of USB3.0 data transmission and ensure that the camera does not lose frames when working.

14.5 Binning

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.

14.6 Power Supply and Cooling System

MaxCam series adopts DC19V power supply, SC-ITR series and SC-CTR series adopts DC12V power supply. When DC19V or DC12V power supply is plugged in, both the camera cooling system and the imaging system use a unified 19V or 12V power supply.

When the power 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.

The cooling system of the camera is TEC cooling, using an external cooling structure and fan assisted cooling, the operating temperature can be adjusted to a specific value, the effective cooling temperature can be lower than the ambient temperature 10-25°C, the efficient cooling system ensures a very low level of dark current.

TEC system adopts PID algorithm to control, so that the TEC can be accurately adjusted to the target temperature, and the temperature deviation is 0.1°C.

There is a Cooling group on the left sidebar in EHDView. 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 time, EHDView can display the current temperature in real time, as shown in Figure 14-2.

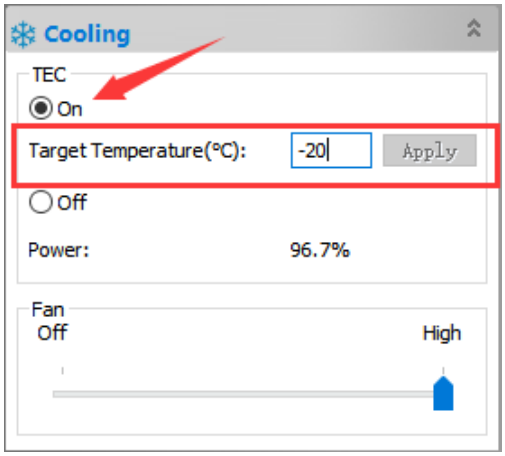


Figure 14-2 TEC settings

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 Figure 14-3.

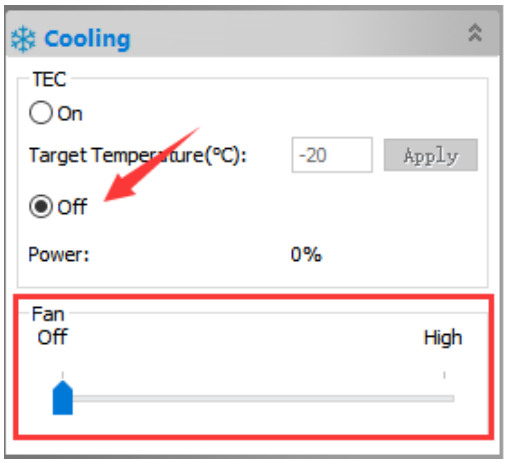


Figure 14-3 Fan settings

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.

15 Trigger Mode and its Configuration

15.1 Video Mode and Trigger Mode

The trigger function can be found on the Capture & Resolution group on the Camera Sidebar in EHDView. When the camera is opened, it is in Video Mode as shown in Figure 15-1 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 Mode check box.

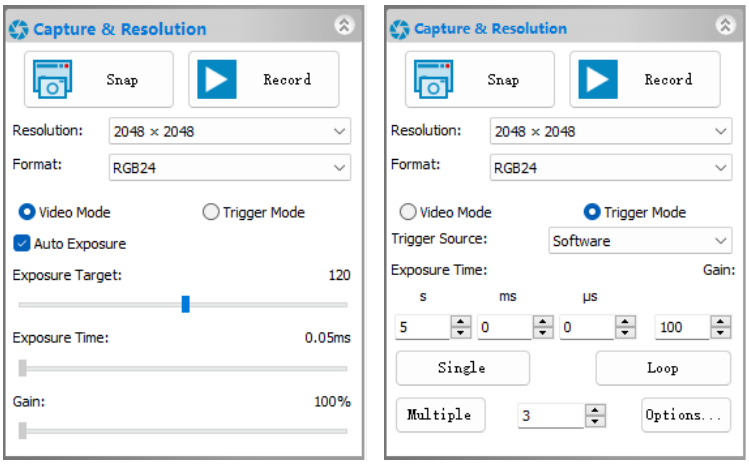


Figure 15-1 Video Mode and Trigger Mode on the Capture & Resolution group in EHDView

After the Trigger Mode is checked, the Capture & Resolution group will switch to Trigger Mode as shown in Figure 15-1 on the right. Where, the Trigger Source, Exposure Time, Gain, Single, Loop, Multiple, Frame Box, and Options can be set.

15.2 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. Figure 15-2 shows the possible Trigger Sources. Table 15-1 shows the designed Trigger Source descriptions and possible capture styles for ToupTek camera.

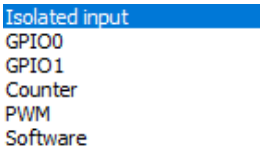
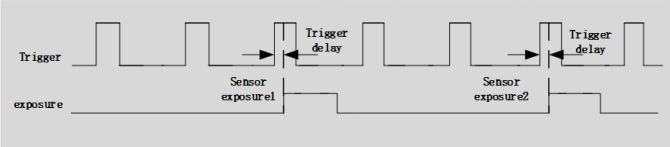
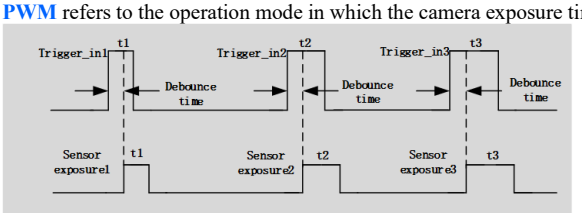
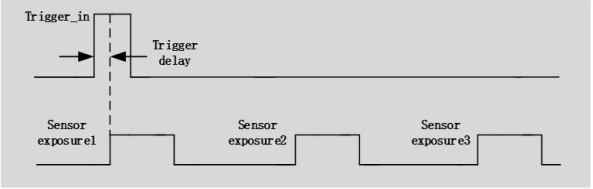


Figure 15-2 Possible Trigger Sources

Table 15-1 Description of possible Trigger Sources and their capture styles

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, the

	camera 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;
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 EHDView, **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;
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;

15.3 The trigger capture and IO Control configurations

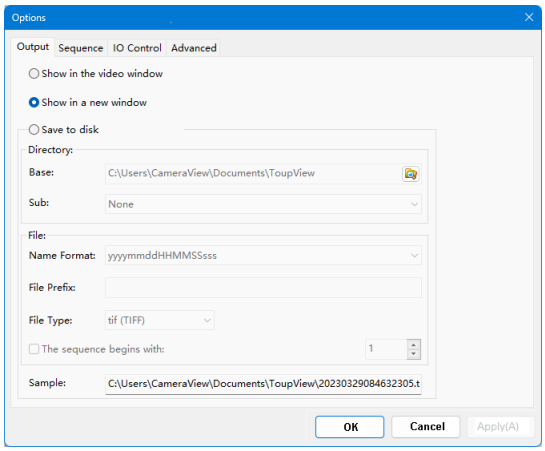


Figure 15-3 Options>Output page

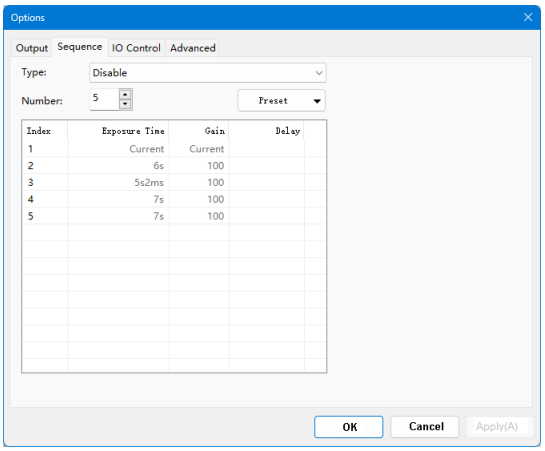


Figure 15-4 Options>Sequence page

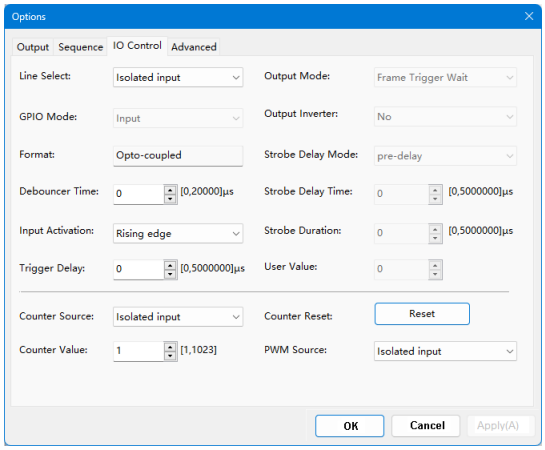


Figure 15-5 Options>IO Control page

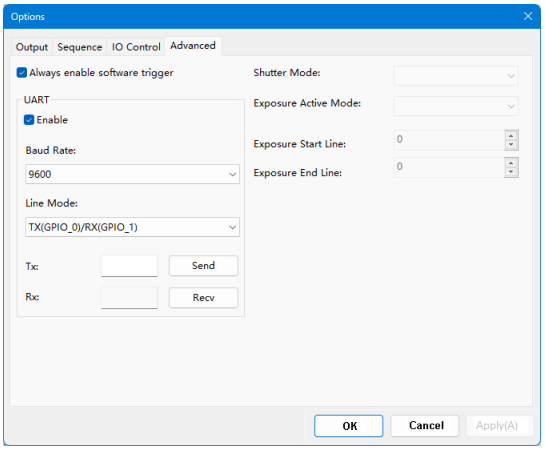


Figure 15-6 Options>Advanced page

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 15-2 below.

About the captured file operation style, one can find it on the Option>Output page;

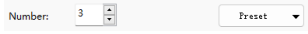
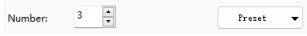
About the Sequence setup, one can find it on the Option>Sequence page;

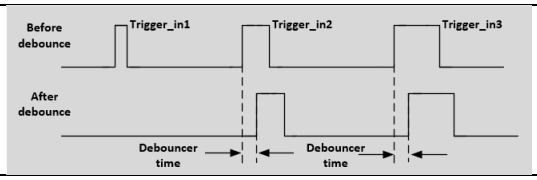
About the camera pin IO Control style, one can find it on the Options>IO Control page;

About the Always enable software trigger and UART setup, Shutter Mode, and Exposure Active Mode, one can find it on the Options>Advance page.

Table 15-2 Options property sheet for Trigger Source or camera pin configuration

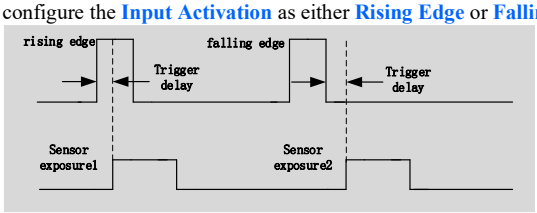
Pages	Items	Descriptions

Output page	**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;
Sequence page	**Type** Disable Plan Hardware	**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** list under  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 page	**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;



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**;

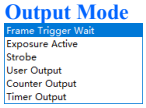


Also can be configure as **high level** or **low level**. When **high level** is selectd, the camera keeps triggering the frame when the input signal is high; When **low level** is selectd, the camera keeps triggering the frame when the input signal is low;

Trigger Delay

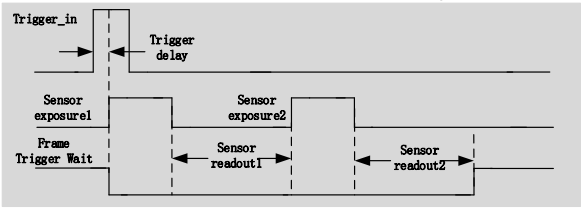
When **Isolated input**, **GPIO0** or **GPIO1** is chosen in the **Line Select** combo box and **GPIO0** or **GPIO1** is configured as **Input** in the **GPIO Mode** combo box, the **Trigger Delay** will be enabled for the user to input the **Trigger Delay** time between 0 to 5000000us;
If the **Trigger Delay** time is set to 1000000us, the camera will wait for 1s to capture the image after receiving the trigger signal;

Output Mode

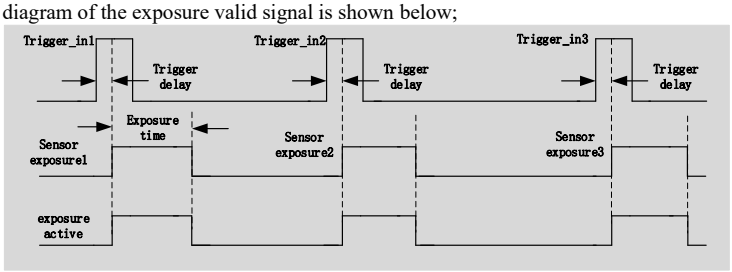


When **Isolated output**, **GPIO0** or **GPIO1** is selected in the **Line Select** combo box and **GPIO0** or **GPIO1** is configured as **Output** in the **GPIO Mode** combo box, the **Output Mode** will be enabled. It can be **Frame Trigger Wait**, **Exposure Active**, **Strobe**, **User Output**, **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;



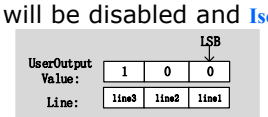
Exposure Active: when this signal is high, it means the sensor is exposing. This signal can be used to control an external mobile device to remain stationary or move at low speed while the camera is at exposure. The timing diagram of the exposure valid signal is shown below;



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;

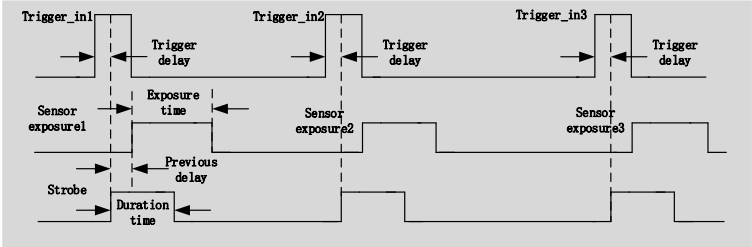
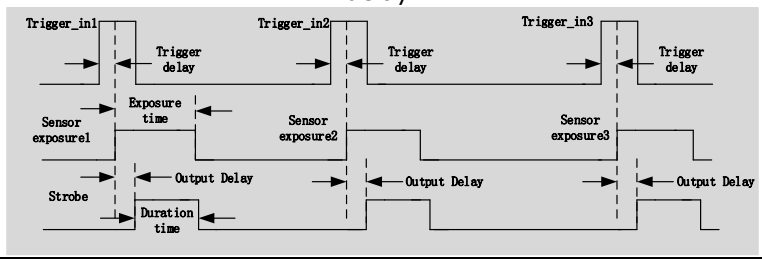
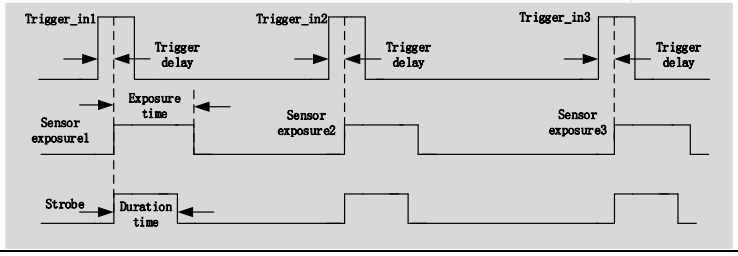
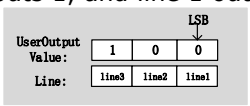
When Strobe is chosen, **Strobe Delay Mode**, **Strobe Delay Time**, **Strobe Duration** will be enabled;

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;



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	Strobe can be used to control external devices such as the strobe, and the effective level duration, delay time, and pre-delay time of the strobe signal can be set; When the **Output Mode** is **Strobe**, **Strobe Delay Mode** will be enabled. It can be **pre-delay** or **delay**;
	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** in Table 15-1 for detail;
	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 page	**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;

16 Application

16.1 Application installation

In terms of software, customers are welcome to visit our website: https://www.ehd.de/ to download the latest EHDView, also be used with ASCOM, DirectShow interface. 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.

16.2 Introduction to EHDView

EHDView is a professional software that integrates camera control, image acquisition and processing, image browsing and analysis functions. EHDView 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.
- Supports all ToupTek cameras

16.2.1 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

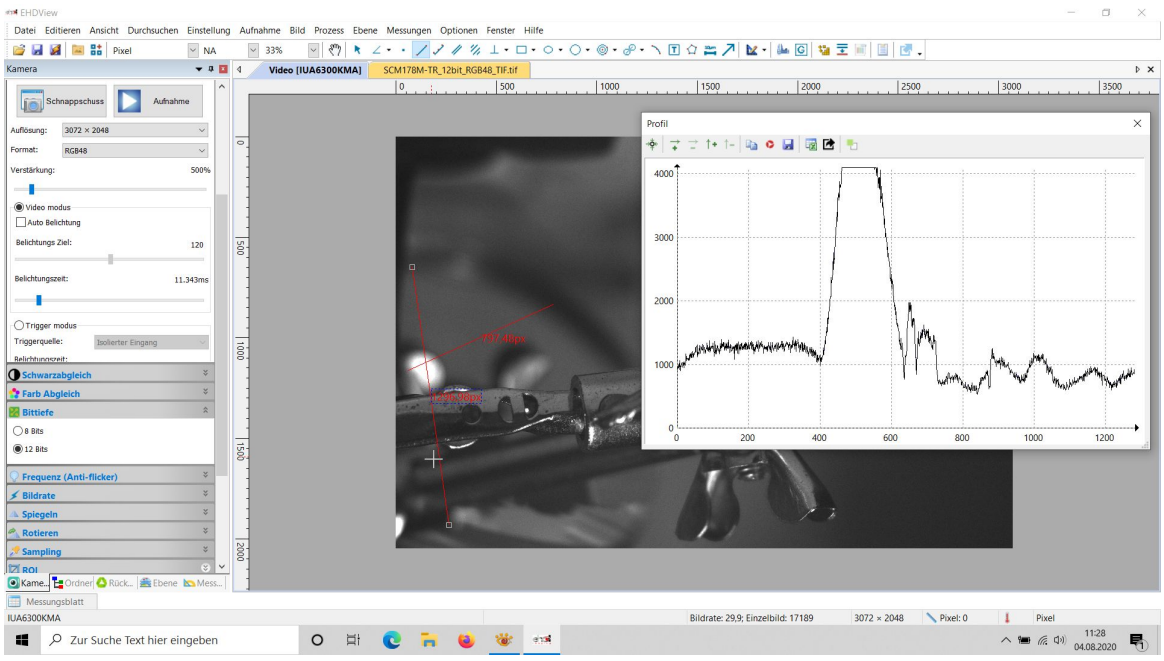


Figure 16-1 EHDView video window

16.2.2 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.)

16.2.3 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 EHDView 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

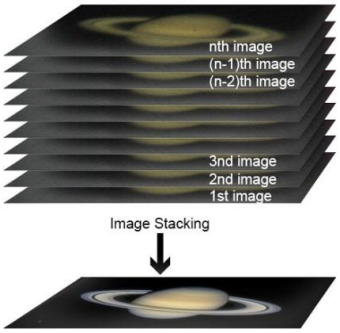


Figure 16-2 Image overlay denoising

16.2.4 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

16.2.5 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

17 Software development instructions

17.1 SDK description

The download link of the SDK is as follows:

www.ehd.de/driver

17.1.1 SDK support platform

- Win32:
  x86: XP SP3 and above; the CPU needs to support at least the SSE2 instruction set.

  x64: Win7 and above.

  arm: Win10 and above.

  arm64: Win10 and above.
- WinRT: x86, x64, arm, arm64; Windows 10 and above.
- macOS: x86 and x64 bundle; macOS 10.10 and above.
- Linux: core 2.6.27 and above.
  x86: The CPU needs to support at least the SSE3 instruction set; GLIBC 2.8 and above.

  x64: GLIBC 2.14 and above.

  armel: GLIBC 2.17 and above; compiled by toolchain arm-linux-gnueabi (version 4.9.2).

  armhf: GLIBC 2.17 and above; compiled by toolchain arm-linux-gnueabihf (version 4.9.2).

  arm64: GLIBC 2.17 and above; compiled by toolchain aarch64-linux-gnu (version 4.9.2).
- Android: arm, arm64, x86, x64; compiled by android-ndk-r18b.

17.1.2 Introduction to SDK content

nncam series 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:
  nncam.h, the C/C++ header file.
- win: Microsoft Windows platform
  file
  - dotnet:
    nncam.cs, supports C#. nncam.cs uses P/Invoke to call nncam.dll. Please copy nncam.cs to your C# project for use.

    nncam.vb, supports VB.NET. nncam.vb uses P/Invoke to call nncam.dll. Please copy nncam.vb to your VB.NET project for use.
  - x86:

    nncam.lib, x86 lib file.

    nncam.dll, x86 dynamic library file.

    democpp.exe, x86 C++ demo execute the procedure.
- x64:

  nncam.lib, x64 lib file.

  nncam.dll, x64 dynamic library file.

  democpp.exe, x64 C++ demo execute the

  procedure.
- arm:
  nncam.lib, arm lib file.

nncam.dll, arm dynamic library file.

- arm64:

  nncam.lib, arm64 lib file.

  nncam.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 nncam.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 nncam.cat, nncam.inf and nncam.sys.

  The x64 folder contains the x64 kernel-mode driver files, including nncam.cat, nncam.inf and nncam.sys.

- 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 ModeTrigger 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-nncam.rules, udev rule file.

  Please refer to: http://reactivated.net/writing_udev_rules.html.

- c#: nncam.cs, Support. Net Core C#. nncam.cs uses P/Invoke to call libnncam.so. Please copy nncam.cs to your C# project for use.
- x86: libnncam.so, x86 version so file.
- x64: libnncam.so, x64 version so file.
- armel: libnncam.so, armel version so file, toolchain is arm-linux-gnueabi.
- armhf: libnncam.so, armhf version so file, toolchain is arm-linux-gnueabihf.

- arm64: libnncam.so, arm64 version so file, toolchain is aarch64-linux-gnu.
- android: libnncam.so for four architectures of Android platform arm, arm64, x86, x64.
- mac: macOS platform files.
- python: nncam.py and example code.
- java: nncam.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.
- extras:
- directshow: DirectShow SDK and demo program.
- twain: TWAIN SDK.
- labview: Labview SDK and demo program.
- matlab: MatLab demo program.

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