

User Manual for Scientific Cameras



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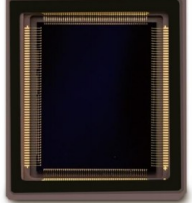
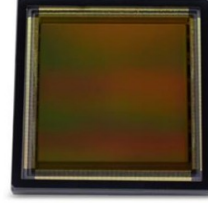
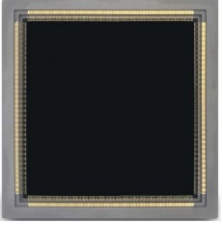
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1 Product List

1.1 Scientific High Sensitivity Camera Specifications (9)

1.1.1 sMAX Series (7)

Sensor	GSENSE2020BSI 	GSENSE4040 	GSENSE4040BSI 
Camera model	sMAX04BM sMAX04BM-U100 sMAX04BM-CL100	sMAX16AM-U3-CL sMAX16AM-U3-CL-GPS	sMAX16BM-U3-CL sMAX16BM-U3-CL-GPS
Pixel size	6.5μm x 6.5μm	9μm x 9μm	9μm x 9μm
Sensor size	1.2"	3.2"	3.2"
Resolution	2048 x 2048 1024 x 1024 (bin 2x2)	4096 x 4096 2048 x 2048 (bin 2x2)	4096 x 4096 2048 x 2048 (bin 2x2)
Spectral range	200nm-1100nm	300nm-1000nm	200nm-1100nm
QE	95%@560nm	74%@600nm	90%@550nm
Data Format	8bit / 11bit / 12bit / 16bit	8bit / 12bit / 16bit	8bit / 12bit / 16bit
Target application	Fluorescence imaging Spectral analysis Gene sequencing Semiconductor inspection	Fluorescence imaging Spectral analysis Astro observation	Fluorescence imaging Spectral analysis Astro observation Semiconductor inspection

1.1.2 sCCD Series (1)

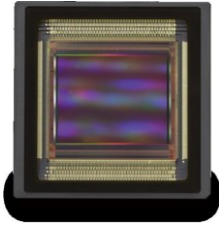
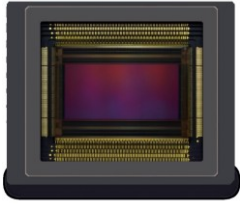
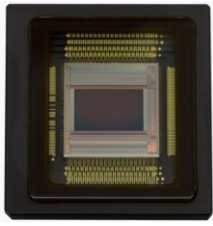
Sensor	E2V CCD261 
Camera model	sCCD01AM Coming soon
Pixel size	15μm x 15μm
Sensor size	30.7mm x 4.0mm
Resolution	2048 x 264
Spectral range	250nm-1050nm
QE	95%@800nm
Data Format	8bit / 16bit
Target application	Raman spectra detection Photoluminescence / Fluorescence Hyperspectral imaging

1.1.3 sNIRII Series (2)

Sensor	Nationally produced InGaAs Image sensor	
Camera model	sNIRII640B-U3	sNIRII640A-U3-10G Coming soon
Pixel size	15μm x 15μm	
Sensor size	3/4"	
Resolution	640 x 512	
Spectral range	900nm-1700nm	
QE	TBD	
Data Format	8bit / 16bit	
Target application	Near-infrared II-region in vivo microscopy imaging	

1.2 Scientific High Speed Camera Specifications (6)

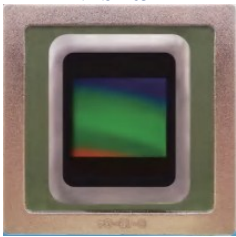
1.2.1 SS Series

Sensor	GSPRINT4521 	GSPRINT4510 	GSPRINT4502 
Camera model	SS21MPA-U3-CXP SS21MMA-U3-CXP Coming soon	SS10MPA-U3-CXP SS10MMA-U3-CXP Coming soon	SS02MPA-U3-CXP SS02MMA-U3-CXP Coming soon
Pixel size	4.5μm x 4.5μm	4.5μm x 4.5μm	4.5μm x 4.5μm
Sensor size	1.86"	1.44"	0.67"
Resolution	5120 x 4096 2560 x 2048 (bin 2x2)	4608 x 2176 2304 x 1088 (bin 2x2)	2048 x 1216 1024 x 608 (bin 2x2)
Spectral range	300nm-1100nm	300nm-1100nm	300nm-1100nm
QE	62.8%@520nm (Mono)	63%@550nm (Mono)	65.7%@550nm (Mono)
Data Format	8bit / 10bit / 12bit	8bit / 10bit / 12bit	8bit / 10bit / 12bit
Target application	High speed industrial inspection High-end photography industry	High speed industrial inspection High-end photography industry	High speed industrial inspection High-end photography industry

1.2.2 sTDI Series High-Speed TDI Line-Scan Cameras

Sensor	Gpixel GLT5008BSI			
Camera model	sTDI08KA-UV-CoF500K	sTDI08KA-UV-CoF1000K	sTDI08KA-VIS-CoF500K	sTDI08KA-VIS-CoF1000K
Sensor type	BSI sCMOS TDI			
Pixel size	5μm x 5μm			
Resolution	P1: 8208 pixels x 256 stages P2: 8208 pixels x 32 stages			
Spectral range	180nm-1100nm	180nm-1100nm	300nm-1100nm	300nm-1100nm
Maximum line rate	500KHz@8bit 428KHz@10bit 380KHz@12bit	1000KHz@8bit/10bit	500KHz@8bit 428KHz@10bit 380KHz@12bit	1000KHz@8bit/10bit
TDI stages	P1: 4 / 32 / 64 / 128 / 192 / 224 / 252 / 256 P2: 2 / 4 / 8 / 16 / 24 / 28 / 30 / 32			
Data interface	QSFP+ / QSFP28			
Data format	8-bit / 10-bit / 12-bit	8-bit / 10-bit	8-bit / 10-bit / 12-bit	8-bit / 10-bit
Target applications	Semiconductor inspection, display panel inspection, high-speed industrial inspection, and high-speed line-scan imaging			

1.3 Scientific High Resolution Camera Specifications (1)

Sensor	VPS2163A 
Camera model	SR600MMA Coming soon
Pixel size	0.5μm x 0.5μm
Sensor size	1.08"
Resolution	20480 x 27200
Spectral range	TBD
QE	TBD
Data Format	8bit / 10bit
Target application	Microscopic observation of cells or organisms

2 High Sensitivity Camera Specification (9)

2.1 sMAX04BM

Table 2-1 sMAX04BM camera specifications

Parameter \ Model		sMAX04BM	sMAX04BM-U100	sMAX04BM-CL100
Camera				
Sensor model		GSENSE2020BSI		
Sensor type		CMOS		
Spectral range		200nm - 1100nm		
pixel size		6.5 μm x 6.5 μm		
Target size		1.2"		
Resolution		2048 x 2048 1024 x 1024 (bin 2x2)		
Frame Rate		72.5fps@2048x2048 72.5fps@1024x1024	89fps@2048x2048 100fps@1024x1024	108fps@2048x2048 108fps@1024x1024
Memory		512MB (4Gb)		
Conversion gain	11bit	1.03		
	12bit	0.42 (HCG) 13.33 (LCG)		
	12bit CMS	0.43		
	12bit Global reset	0.44 (HCG) 1.92 (LCG)		
	HDR 11HL	0.58		
	HDR 12HL	0.54		
Dynamic Range	11bit	61.38dB		
	12bit	59.73dB (HCG) 67.17dB (LCG)		
	12bit CMS	64.12dB		
	12bit Global reset	58.63dB (HCG) 61.27dB (LCG)		
	HDR 11HL	91.83dB		
	HDR 12HL	86.02dB		
Read noise	11bit	1.69e-		
	12bit	1.72e- (HCG) 23.25e- (LCG)		
	12bit CMS	1.07e-		
	12bit Global reset	2.08e- (HCG) 6.62e- (LCG)		
	HDR 11HL	0.97e-		
	HDR 12HL	1.78e-		
Full well charge	11bit	1.98ke-		
	12bit	1.67ke- (HCG) 53.07ke- (LCG)		
	12bit CMS	1.71ke-		
	12bit Global reset	1.78ke- (HCG) 7.66ke- (LCG)		
	HDR 11HL	37.85ke-		
	HDR 12HL	35.56ke-		
SNR	11bit	32.97dB		
	12bit	32.22dB (HCG) 47.25dB (LCG)		
	12bit CMS	32.34dB		
	12bit Global reset	32.49dB (HCG) 38.85dB (LCG)		
	HDR 11HL	45.78dB		
	HDR 12HL	45.51dB		
Sensitivity		1.1x10 ⁸ e-/ ((W/m ²).s)@550nm		
Dark current		Typical: 0.45e-/s/pix@ -30°C die temp		
QE		95%@560nm		
Exposure time range		12us-300s	12us-10s	12us-10s
Gain Range		1x – 21x	1x	1x – 21x
Shutter mode		Rolling shutter / Global reset		
Binning mode		Software 2x2, 3x3, 4x4, Hardware FPGA 2x2		
Data interface		USB3.0	USB3.0	CameraLink
Digital I/O		One optical-coupling isolated input, one optical-coupling isolated output, tow non-isolated input and output		
Data Format		8bit / 11bit / 12bit / 16bit		

Cooling temperature difference	Below room temperature 40 degrees Celsius
General parameters	
Power supply	DC12V power supply
Power consumption	<25W
Temperature	Working temperature -30 ~ 60 ℃, storage temperature - 40 ~ 85 ℃
Humidity	20%-80% , non-condensing
Size	80*80*101.5
Weight	860g
Lens mount	C-mount interface
Software	Provide Complete SDK (software development kit) / ToupView / SDK development kit and CL View software based on Delsa acquisition card

* Currently, the sMAX04BM is available in AR and UV versions; see Section 8, Filters, below for details

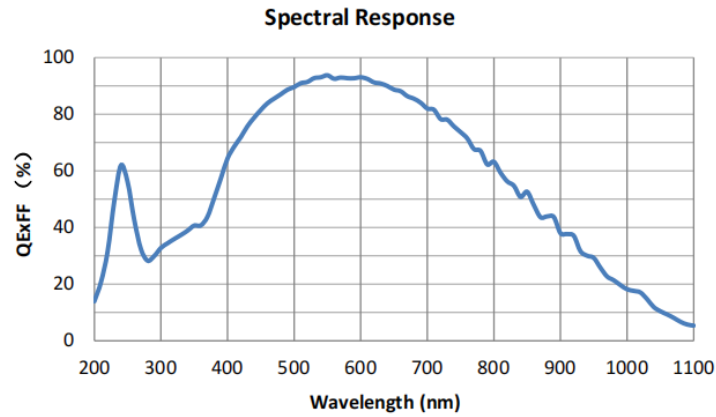


Figure 2.1-1 The spectral QE of GSENSE2020BSI

2.2 sMAX16AM

Table 2-2 sMAX16AM camera specifications

Model		sMAX16AM-U3-CL sMAX16AM-U3-CL-GPS
Parameter		
Camera		
Sensor model		GSENSE4040
Sensor type		CMOS
Spectral range		300nm - 1000nm
pixel size		9 μm x 9 μm
Target size		3.2"
Resolution		4096 x 4096 2048 x 2048 (bin 2x2)
Frame Rate	USB3	20fps@4096x4096, 80fps@2048x2048
	CameraLink	23fps@4096x4096, 90fps@2048x2048
Memory		1024MB (8Gb)
Conversion gain	12bit	0.86e-/DN (HCG 16.5x) 20.94e-/DN (LCG 2.8x)
	12bit Global reset	TBD
	HDR16	0.94e-/DN
Dynamic Range	12bit	58.5dB (HCG 16.5x) 67.5dB (LCG 2.8x)
	12bit Global reset	TBD
	HDR16	82.5dB
Read noise	12bit	4.06e- (HCG 16.5x) 35.61e- (LCG 2.8x)
	12bit Global reset	TBD
	HDR16	4.59e-
Full well charge	12bit	3.45ke- (HCG 16.5x) 84.33ke- (LCG 2.8x)
	12bit Global reset	TBD
	HDR16	61.49ke-
SNR	12bit	35.4dB (HCG 16.5x) 49.3dB (LCG 2.8x)
	12bit Global reset	TBD
	HDR16	47.9dB
Sensitivity		23.82 V/ (lux-s)@600nm
Dark current		0.15e-/s/pix
QE		74% @ 600nm
Dark signal inhomogeneity		0.5e-
Optical signal inhomogeneity		0.2%
Exposure time range		12us-3600s
Gain Range		1x – 16.5x
Shutter mode		Rolling shutter / Global reset
Binning mode		Software 2x2, 3x3, 4x4, Hardware 2x2
Data interface		USB3.0 / CameraLink
Digital I/O		One optical-coupling isolated input, one optical-coupling isolated output, tow non-isolated input and output
Data Format		8bit / 12bit / 16bit
Cooling temperature difference		Below room temperature 40 degrees Celsius
General parameters		
Power supply		DC19V 4.74A power supply
Power consumption		TEC ON: 58.7W; TEC OFF: 16.2W; TEC OFF + CameraLink Only: 8.2W
Temperature		Working temperature -30 ~ 45 ℃, storage temperature - 40 ~ 60 ℃
Humidity		0-95%
Size		100*100*127.7
Weight		1317g
Lens mount		M54 x 0.75
Software		ToupView, CLView software based on Delsa acquisition card, LabView, MATLAB, etc
SDK		C, C++, C#, Python
Operating system		Windows, Linux

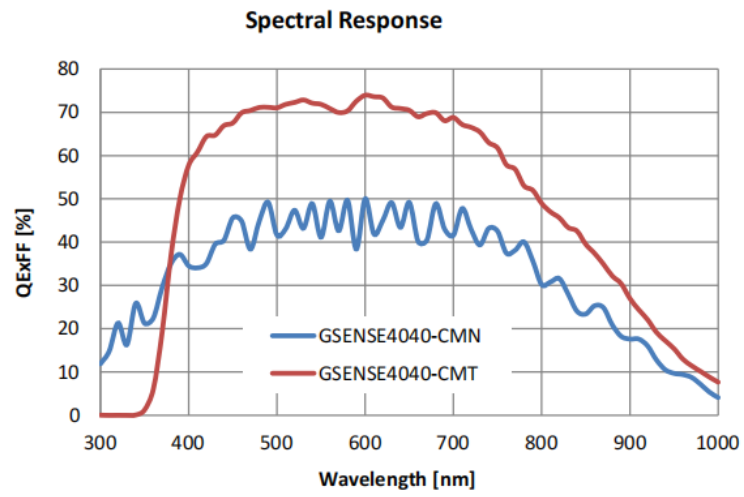


Figure 2.2-1 The spectral QE of GSENSE4040

2.3 sMAX16BM

Table 2-3 sMAX16BM camera specifications

Model		sMAX16BM-U3-CL sMAX16BM-U3-CL-GPS
Parameter		
Camera		
Sensor model		GSENSE4040BSI
Sensor type		CMOS
Spectral range		200nm - 1100nm
pixel size		9 μm x 9 μm
Target size		3.2"
Resolution		4096 x 4096 2048 x 2048 (bin 2x2)
Frame Rate	USB3	20fps@4096x4096
	CameraLink	23fps@4096x4096
Memory		1024MB (8Gb)
Conversion gain	12bit	0.35e-/DN (HCG 12x) 10.42e-/DN (LCG 3x)
	12bit Global reset	TBD
	HDR16	TBD
Dynamic Range	12bit	55.0dB (HCG 12x) 62.4dB (LCG 3x)
	12bit Global reset	TBD
	HDR16	TBD
Read noise	12bit	4.06e- (HCG 12x) 35.61e- (LCG 3x)
	12bit Global reset	TBD
	HDR16	TBD
Full well charge	12bit	1.30ke- (HCG 12x) 39.2ke- (LCG 3x)
	12bit Global reset	TBD
	HDR16	TBD
SNR	12bit	30.7dB (HCG 12x) 45.9dB (LCG 3x)
	12bit Global reset	TBD
	HDR16	TBD
Sensitivity		26.58 V/ (lux-s)@550nm
Dark current		0.15e-/s/pix
QE		90% @ 550nm
Dark signal inhomogeneity		0.5e-
Optical signal inhomogeneity		0.2%
Exposure time range		12us-3600s
Gain Range		1x – 12x
Shutter mode		Rolling shutter / Global reset
Binning mode		Software 2x2, 3x3, 4x4
Data interface		USB3.0 / CameraLink
Digital I/O		One optical-coupling isolated input, one optical-coupling isolated output, tow non-isolated input and output
Data Format		8bit / 12bit / 16bit
Cooling temperature difference		Below room temperature 40 degrees Celsius
General parameters		
Power supply		DC19V 4.74A power supply
Power consumption		TEC ON: 58.7W; TEC OFF: 16.2W; TEC OFF + CameraLink Only: 8.2W
Temperature		Working temperature -30 ~ 45 ℃, storage temperature - 40 ~ 60 ℃
Humidity		0-95%
Size		100*100*127.7
Weight		1317g
Lens mount		M54 x 0.75
Software		ToupView, CLView software based on Delsa acquisition card, LabView, MATLAB, etc
SDK		C, C++, C#, Python
Operating system		Windows, Linux

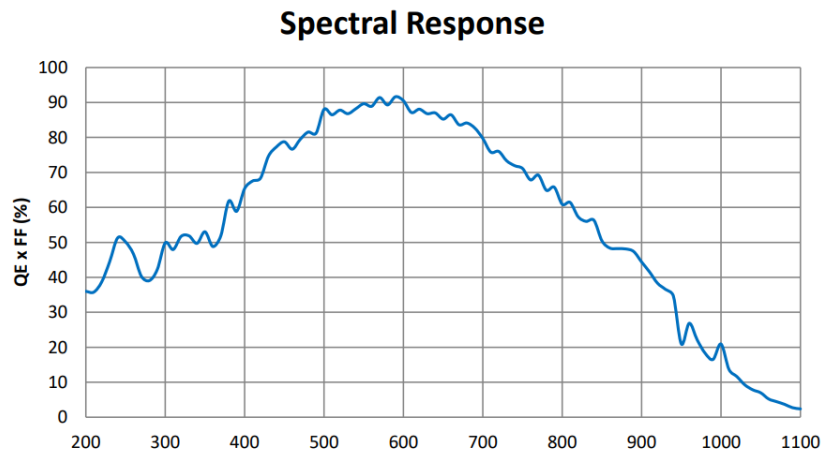


Figure 2.3-1 The spectral QE of GSENSE4040BSI

2.4 sCCD01AM

Table 2-4 sCCD01AM camera specifications

Parameter	Model
sCCD01AM	
Camera	
Sensor model	E2V CCD261
Sensor type	CCD image sensor
Spectral range	300 nm–1000 nm
Pixel size	15 μm $\times$ 15 μm
Target size	30.7 mm $\times$ 4.0 mm
Frame rate & resolution	12 fps @ 2048 $\times$ 1
Memory	512 MB (4 Gb)
Conversion gain	7 e-/ADU
Dynamic range	86.5 dB
Read noise	22 e- RMS
Full well charge	459 ke-
SNR	56.6 dB
Sensitivity	-
Dark current	184 e-/pixel/s @ -35°C (2048 $\times$ 1 binning)
QE	95% @ 800 nm
Exposure time range	≤ 60 min
Gain range	1 $\times$
Shutter mode	N/A
Binning mode	1 $\times$ 264 binning
Data interface	USB 3.0
Digital I/O	N/A
Data format	8-bit / 16-bit
Cooling temperature difference	50°C below ambient temperature
General parameters	
Power supply	Powered by a 12 V, 5 A power adapter
Power consumption	N/A
Temperature	Operating temperature: -20–45°C; storage temperature: -40–60°C
Humidity	0–95%
Dimensions	100 mm $\times$ 80 mm $\times$ 79.25 mm
Weight	800 g
Lens mount	M42 $\times$ 1 mm
Software	ToupView, LabVIEW, MATLAB, etc.
SDK	C, C++, C#, Python
Operating system	Windows, Linux

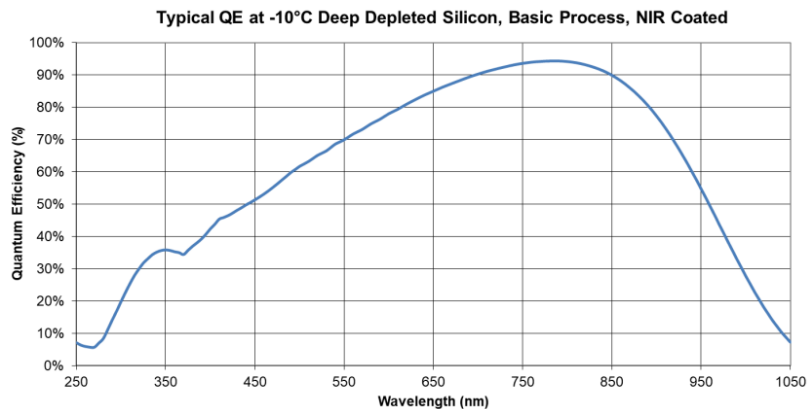


Figure 2.4-1 The spectral QE of CCD261

2.5 sNIRII640A-U3-10G

Table 2-5 sNIRII640A-U3-10G camera specifications

Parameter	Model
sNIRII640A-U3-10G Coming soon	
Camera	
Sensor model	Nationally produced InGaAs Image sensor
Spectral range	900nm - 1700nm
pixel size	15 μm x 15 μm
Target size	3/4"
Resolution	TBD@640 x 512
Memory	512MB (4Gb)
Conversion gain	TBD
Dynamic Range	TBD
Read noise	TBD
Full well charge	75ke-
SNR	TBD
Sensitivity	TBD
Dark current	TBD
QE	TBD
Dark signal inhomogeneity	TBD
Optical signal inhomogeneity	TBD
Exposure time range	TBD
Gain Range	TBD
Shutter mode	Global Shutter
Binning mode	Software 2x2, 3x3, 4x4
Data interface	USB3.0 / 10GigE
Digital I/O	TBD
Data Format	8bit / 16bit
Cooling temperature difference	Below room temperature 40 degrees Celsius
General parameters	
Power supply	DC19V 4.74A power supply
Power consumption	TBD
Temperature	Working temperature -30 ~ 45 $^{\circ}\text{C}$, storage temperature - 40 ~ 60 $^{\circ}\text{C}$
Humidity	0-95%
Size	TBD
Weight	TBD
Lens mount	TBD
Software	ToupView, CLView software based on Delsa acquisition card, LabView, MATLAB, etc
SDK	C, C++, C#, Python
Operating system	Windows, Linux

2.6 sNIRII640B-U3

Table 2-6 sNIRII640B-U3 camera specifications

Parameter	Model
	sNIRII640B-U3
	Camera
Sensor Model	Nationally produced InGaAs Image sensor
Spectral Range	900nm-1700nm
Pixel Size	15 μ m $\times$ 15 μ m
Target Size	1/2"
Frame Rate & Resolution	TBD@640 x 512
Memory	512MB (4Gb)
Conversion Gain	0.96 e-/DN (HCG), 5.36 e-/DN (MCG), 145 e-/DN (LCG)
Dynamic Range	55.8 dB (HCG), 58.1 dB (MCG), 58.3 dB (LCG)
Read Noise	22.8 e- (HCG), 106 e- (MCG), 2708 e- (LCG)
Full Well Charge	14 ke- (HCG), 85 ke- (MCG), 2216 ke- (LCG)
Max SNR	41.5 dB (HCG), 49.3 dB (MCG), 63.4 dB (LCG)
Dark Current	MCG 193.909 / HCG 630.516 / LCG 131.561;
QE	—
Dark Signal Inhomogeneity	—
Optical Signal Inhomogeneity	—
Exposure Time Range	16 μ s~5s
Shutter Mode	Global Shutter
Binning Mode	Software 2x2, 3x3, 4x4
Data Interface	USB3
Digital I/O	1 opto-isolated input, 1 opto-isolated output, 2 non-isolated I/O ports
Data Format	8-bit / 16-bit
Cooling Temperature Difference	Below room temperature 50 degrees Celsius
	General parameters
Power supply	DC19V 4.74A power supply
Power consumption	TBD
Temperature	Working temperature -30 ~ 45 °C, storage temperature - 40 ~ 60 °C
Humidity	0-95%
Size	137.8mm $\times$ 100mm $\times$ 100mm
Weight	TBD
Lens mount	C 接口
Software	ToupView, CLView software based on Delsa acquisition card, LabView, MATLAB, etc
SDK	C, C++, C#, Python
Operating system	Windows, Linux

3 High Speed Camera Specification

3.1 SS Series (6)

3.1.1 SS21MPA-U3-CXP

Table 3-1 SS21MPA-U3-CXP camera specifications

Parameter	Model	SS21MPA-U3-CXP
Camera		
Sensor model		GSPRINT4521-AVC
Sensor type		CMOS
Spectral range		300nm-1100nm
pixel size		4.5μm x 4.5 μm
Target size		1.86"
Resolution		TBD@5120 x 4096 TBD@2560 x 2048 (bin 2x2)
Memory		1024MB (8Gb)
Conversion gain		TBD
Dynamic Range		TBD
Read noise		TBD
Full well charge		TBD
SNR		TBD
Sensitivity		TBD
Dark current		TBD
QE		TBD
Exposure time range		TBD
Gain Range		TBD
Shutter mode		Global Shutter
Binning mode		Software 2x2, 3x3, 4x4
Data interface		USB3.0 / CXP
Digital I/O		TBD
Data Format		8bit / 10bit / 12bit
Cooling temperature difference		Below room temperature 40 degrees Celsius
General parameters		
Power supply		DC19V 4.74A power supply
Power consumption		TBD
Temperature		Working temperature -30 ~ 45 °C, storage temperature - 40 ~ 60 °C
Humidity		0-95%
Size		TBD
Weight		TBD
Lens mount		TBD
Software		ToupView, CLView software based on Delsa acquisition card, LabView, MATLAB, etc
SDK		C, C++, C#, Python
Operating system		Windows, Linux

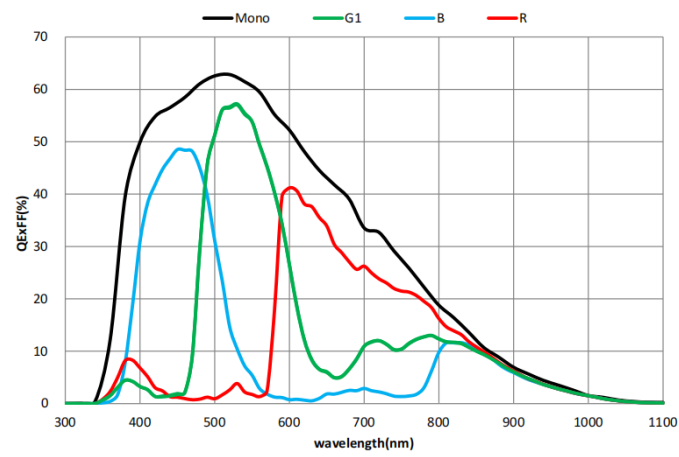


Figure 3.1-1 The spectral QE of GSPRINT4521

3.1.2 SS21MMA-U3-CXP

Table 3-2 SS21MMA-U3-CXP camera specifications

Parameter	Model
SS21MMA-U3-CXP	
Camera	
Sensor model	GSPRINT4521-AVM
Sensor type	CMOS
Spectral range	300nm-1100nm
pixel size	4.5μm x 4.5 μm
Target size	1.86"
Resolution	TBD@5120 x 4096 TBD@2560 x 2048 (bin 2x2)
Memory	1024MB (8Gb)
Conversion gain	TBD
Dynamic Range	TBD
Read noise	TBD
Full well charge	TBD
SNR	TBD
Sensitivity	TBD
Dark current	TBD
QE	62.8%@520nm (Mono)
Exposure time range	TBD
Gain Range	TBD
Shutter mode	Global Shutter
Binning mode	Software 2x2, 3x3, 4x4
Data interface	USB3.0 / CXP
Digital I/O	TBD
Data Format	8bit / 10bit / 12bit
Cooling temperature difference	Below room temperature 40 degrees Celsius
General parameters	
Power supply	DC19V 4.74A power supply
Power consumption	TBD
Temperature	Working temperature -30 ~ 45 °C, storage temperature - 40 ~ 60 °C
Humidity	0-95%
Size	TBD
Weight	TBD
Lens mount	TBD
Software	ToupView, CLView software based on Delsa acquisition card, LabView, MATLAB, etc
SDK	C, C++, C#, Python
Operating system	Windows, Linux

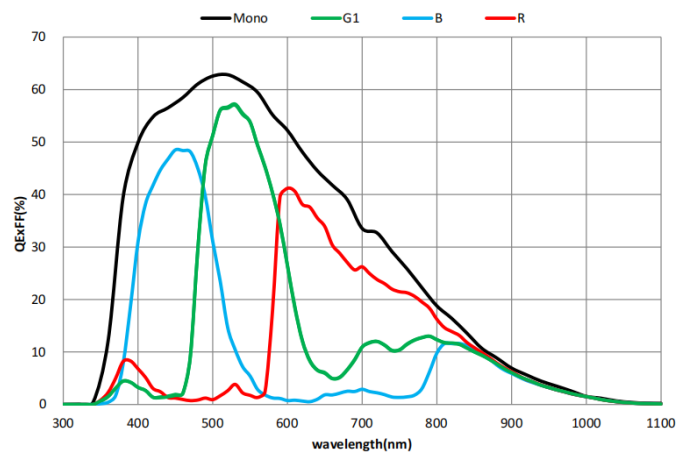


Figure 3.1-2 The spectral QE of GSPRINT4521

3.1.3 SS10MPA-U3-CXP

Table 3-3 SS10MPA-U3-CXP camera specifications

Parameter	Model
SS10MPA-U3-CXP	
Camera	
Sensor model	GSPRINT4510-AVC
Sensor type	CMOS
Spectral range	300nm-1100nm
pixel size	4.5μm x 4.5 μm
Target size	1.44"
Resolution	TBD@4608 x 2176 TBD@2304 x 1088 (bin 2x2)
Memory	1024MB (8Gb)
Conversion gain	TBD
Dynamic Range	TBD
Read noise	TBD
Full well charge	TBD
SNR	TBD
Sensitivity	TBD
Dark current	TBD
QE	TBD
Exposure time range	TBD
Gain Range	TBD
Shutter mode	Global Shutter
Binning mode	Software 2x2, 3x3, 4x4
Data interface	USB3.0 / CXP
Digital I/O	TBD
Data Format	8bit / 10bit / 12bit
Cooling temperature difference	Below room temperature 40 degrees Celsius
General parameters	
Power supply	DC19V 4.74A power supply
Power consumption	TBD
Temperature	Working temperature -30 ~ 45 °C, storage temperature - 40 ~ 60 °C
Humidity	0-95%
Size	TBD
Weight	TBD
Lens mount	TBD
Software	ToupView, CLView software based on Delsa acquisition card, LabView, MATLAB, etc
SDK	C, C++, C#, Python
Operating system	Windows, Linux

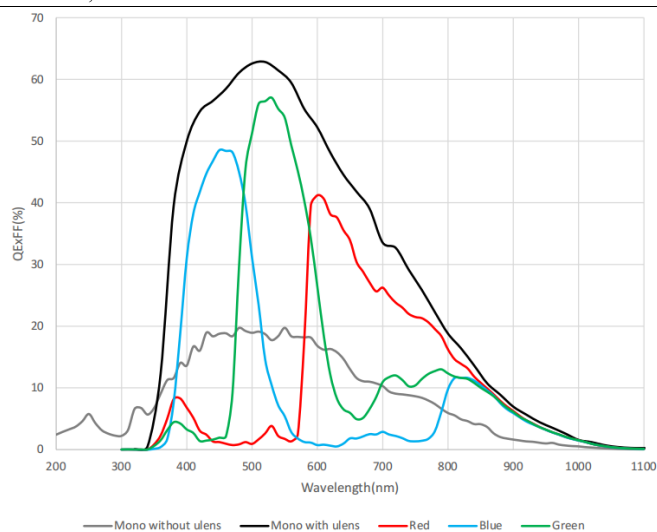


Figure 3.1-3 The spectral QE of GSPRINT4510

3.1.4 SS10MMA-U3-CXP

Table 3-4 SS10MMA-U3-CXP camera specifications

Parameter	Model
SS10MMA-U3-CXP	
Camera	
Sensor model	GSPRINT4510-AVM
Sensor type	CMOS
Spectral range	300nm-1100nm
pixel size	4.5 μ m x 4.5 μ m
Target size	1.44"
Resolution	TBD@4608 x 2176 TBD@2304 x 1088 (bin 2x2)
Memory	1024MB (8Gb)
Conversion gain	TBD
Dynamic Range	TBD
Read noise	TBD
Full well charge	TBD
SNR	TBD
Sensitivity	TBD
Dark current	TBD
QE	63%@550nm (Mono)
Exposure time range	TBD
Gain Range	TBD
Shutter mode	Global Shutter
Binning mode	Software 2x2, 3x3, 4x4
Data interface	USB3.0 / CXP
Digital I/O	TBD
Data Format	8bit / 10bit / 12bit
Cooling temperature difference	Below room temperature 40 degrees Celsius
General parameters	
Power supply	DC19V 4.74A power supply
Power consumption	TBD
Temperature	Working temperature -30 ~ 45 °C, storage temperature - 40 ~ 60 °C
Humidity	0-95%
Size	TBD
Weight	TBD
Lens mount	TBD
Software	ToupView, CLView software based on Delsa acquisition card, LabView, MATLAB, etc
SDK	C, C++, C#, Python
Operating system	Windows, Linux

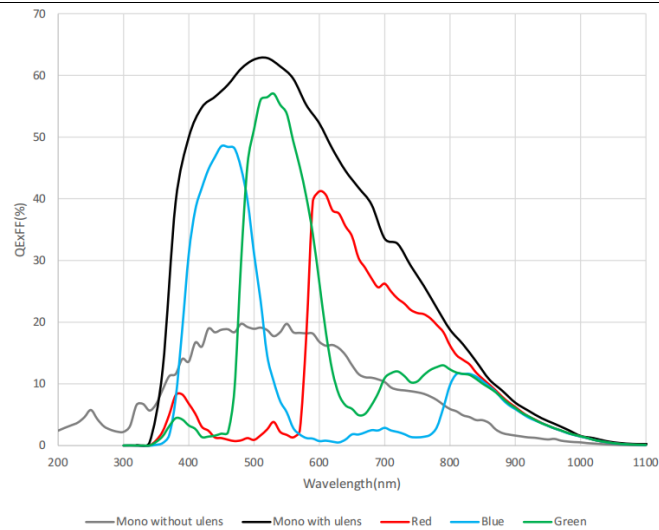


Figure 3.1-4 The spectral QE of GSPRINT4510

3.1.5 SS02MPA-U3-CXP

Table 3-5 SS02MPA-U3-CXP camera specifications

Parameter	Model
SS02MPA-U3-CXP	
Camera	
Sensor model	GSPRINT4502-AVC
Sensor type	CMOS
Spectral range	300nm-1100nm
pixel size	4.5μm x 4.5 μm
Target size	0.67"
Resolution	TBD@2048 x 1216 TBD@1024 x 608 (bin 2x2)
Memory	1024MB (8Gb)
Conversion gain	TBD
Dynamic Range	TBD
Read noise	TBD
Full well charge	TBD
SNR	TBD
Sensitivity	TBD
Dark current	TBD
QE	TBD
Exposure time range	TBD
Gain Range	TBD
Shutter mode	Global Shutter
Binning mode	Software 2x2, 3x3, 4x4
Data interface	USB3.0 / CXP
Digital I/O	TBD
Data Format	8bit / 10bit / 12bit
Cooling temperature difference	Below room temperature 40 degrees Celsius
General parameters	
Power supply	DC19V 4.74A power supply
Power consumption	TBD
Temperature	Working temperature -30 ~ 45 °C, storage temperature - 40 ~ 60 °C
Humidity	0-95%
Size	TBD
Weight	TBD
Lens mount	TBD
Software	ToupView, CLView software based on Delsa acquisition card, LabView, MATLAB, etc
SDK	C, C++, C#, Python
Operating system	Windows, Linux

3.1.6 SS02MMA-U3-CXP

Table 3-6 SS02MMA-U3-CXP camera specifications

Parameter	Model
SS02MMA-U3-CXP	
Camera	
Sensor model	GSPRINT4502-AVM
Sensor type	CMOS
Spectral range	300nm-1100nm
pixel size	4.5μm x 4.5 μm
Target size	0.67"
Resolution	TBD@2048 x 1216 TBD@1024 x 608 (bin 2x2)
Memory	1024MB (8Gb)
Conversion gain	TBD
Dynamic Range	TBD
Read noise	TBD
Full well charge	TBD
SNR	TBD
Sensitivity	TBD
Dark current	TBD
QE	65.7%@550nm (Mono)
Exposure time range	TBD
Gain Range	TBD
Shutter mode	Global Shutter
Binning mode	Software 2x2, 3x3, 4x4
Data interface	USB3.0 / CXP
Digital I/O	TBD
Data Format	8bit / 10bit / 12bit
Cooling temperature difference	Below room temperature 40 degrees Celsius
General parameters	
Power supply	DC19V 4.74A power supply
Power consumption	TBD
Temperature	Working temperature -30 ~ 45 °C, storage temperature - 40 ~ 60 °C
Humidity	0-95%
Size	TBD
Weight	TBD
Lens mount	TBD
Software	ToupView, CLView software based on Delsa acquisition card, LabView, MATLAB, etc
SDK	C, C++, C#, Python
Operating system	Windows, Linux

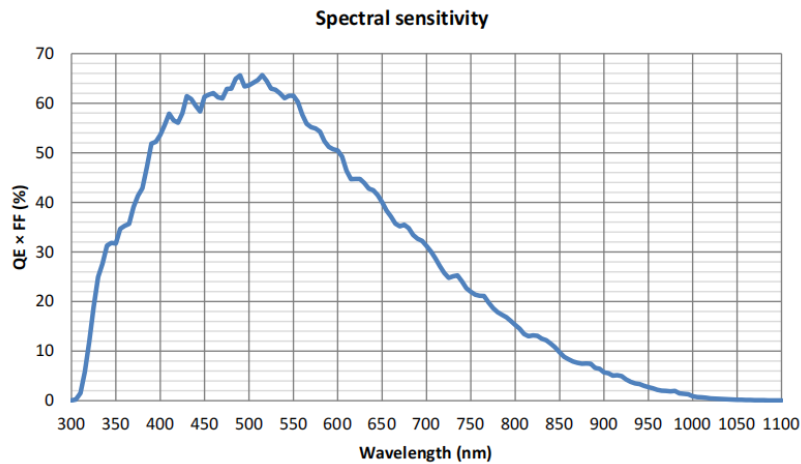


Figure 3.1-5 The spectral QE of GSPRINT4502

3.2 sTDI Series High-Speed TDI Line-Scan Cameras (4)

3.2.1 sTDI08KA-UV-CoF500K

Table 3-7 sTDI08KA-UV-CoF500K camera specifications

Parameter	Model	sTDI08KA-UV-CoF500K
Camera		
Sensor model		Gpixel GLT5008BSI
Sensor type		BSI sCMOS TDI
Spectral range		180 nm–1100 nm
Charge transfer efficiency		≥ 0.99993
Pixel size		$5\ \mu\text{m} \times 5\ \mu\text{m}$
Color/Mono		Mono
Resolution		P1: 8208 pixels $\times$ 256 stages; P2: 8208 pixels $\times$ 32 stages
Maximum line rate		500 kHz @ 8-bit, 428 kHz @ 10-bit, 380 kHz @ 12-bit
TDI stages		P1: 4, 32, 64, 128, 192, 224, 252, 256; P2: 2, 4, 8, 16, 24, 28, 30, 32
Operating mode		TDI, Area
Scan direction control		User control, trigger control
Conversion gain		0.21 e-/DN
System gain		5.12 e-/ADU
Dynamic range		66.9 dB
Read noise		8.22 e-
Full well charge		20.0 ke-
SNR		43.0 dB
Dark current		517 e-/s/pixel @ 10°C
Gain		Analog gain: $\times 1$ to $\times 4$; digital gain: $\times 0.1$ to $\times 16.0$
Binning mode		2×2 , 4×4 , 8×8
ROI		Supported
Data interface		QSFP+ / QSFP28
Cooling method		Air cooling, forced-air cooling, water cooling
External trigger mode		Line trigger, frame trigger, line + frame trigger
Digital I/O		Two 7-pin interfaces. Each interface provides four configurable input/output channels and one RS-485 differential interface.
General parameters		
Power supply		Powered by a 24 V power adapter
Power consumption		TBD
Temperature		Operating temperature: 0–40°C; storage temperature: -20–60°C
Humidity		20%–80%
Dimensions		120 mm $\times$ 120 mm $\times$ 144.5 mm
Weight		2 kg
Lens mount		M72 $\times$ 0.75
Software		ToupView, CLView software based on Delsa acquisition card, LabView, MATLAB, etc
SDK		C, C++, C#, Python
Operating system		Windows, Linux

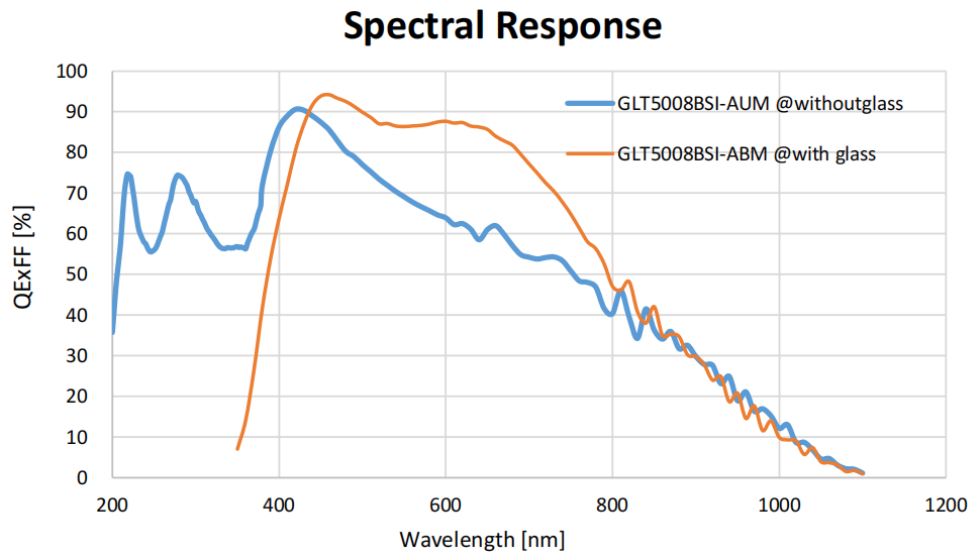


Figure 3.2-1 The spectral QE of GLT5008BSI

3.2.2 sTDI08KA-UV-CoF1000K

Table 3-8 sTDI08KA-UV-CoF1000K camera specifications

Parameter	Model
sTDI08KA-UV-CoF1000K	
Camera	
Sensor model	Gpixel GLT5008BSI
Sensor type	BSI sCMOS TDI
Spectral range	180 nm–1100 nm
Charge transfer efficiency	≥ 0.99993
Pixel size	$5\ \mu\text{m} \times 5\ \mu\text{m}$
Color/Mono	Mono
Resolution	P1: 8208 pixels $\times$ 256 stages; P2: 8208 pixels $\times$ 32 stages
Maximum line rate	1000 kHz @ 8-bit/10-bit
TDI stages	P1: 4, 32, 64, 128, 192, 224, 252, 256; P2: 2, 4, 8, 16, 24, 28, 30, 32
Operating mode	TDI, Area
Scan direction control	User control, trigger control
Conversion gain	0.054 e-/DN
System gain	17.6 e-/ADU
Dynamic range	64.6 dB
Read noise	10.0 e-
Full well charge	17.0 ke-
SNR	42.3 dB
Dark current	517 e-/s/pixel @ 10°C
Gain	Analog gain: $\times 1$ to $\times 4$; digital gain: $\times 0.1$ to $\times 16.0$
Binning mode	2×2 , 4×4 , 8×8
ROI	Supported
Data interface	QSFP+ / QSFP28
Cooling method	Air cooling, forced-air cooling, water cooling
External trigger mode	Line trigger, frame trigger, line + frame trigger
Digital I/O	Two 7-pin interfaces. Each interface provides four configurable input/output channels and one RS-485 differential interface.
General parameters	
Power supply	Powered by a 24 V power adapter
Power consumption	TBD
Temperature	Operating temperature: 0–40°C; storage temperature: -20–60°C
Humidity	20%–80%
Dimensions	120 mm $\times$ 120 mm $\times$ 144.5 mm
Weight	2 kg
Lens mount	M72 $\times$ 0.75
Software	ToupView, CLView software based on Delsa acquisition card, LabView, MATLAB, etc
SDK	C, C++, C#, Python
Operating system	Windows, Linux

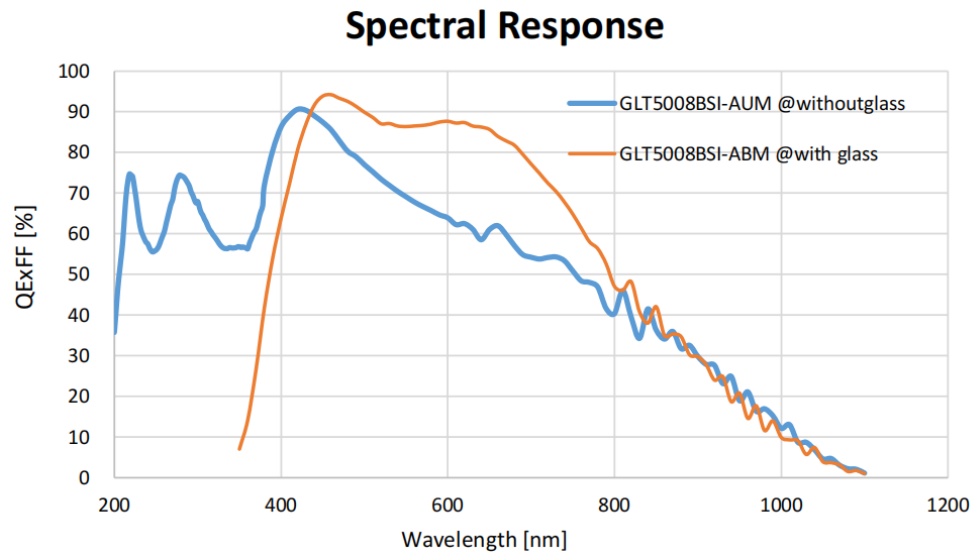


Figure 3.2-2 The spectral QE of GLT5008BSI

3.2.3 sTDI08KA-VIS-CoF500K

Table 3-9 sTDI08KA-VIS-CoF500K camera specifications

Parameter	Model
sTDI08KA-VIS-CoF500K	
Camera	
Sensor model	Gpixel GLT5008BSI
Sensor type	BSI sCMOS TDI
Spectral range	300 nm–1100 nm
Charge transfer efficiency	≥ 0.99993
Pixel size	$5\ \mu\text{m} \times 5\ \mu\text{m}$
Color/Mono	Mono
Resolution	P1: 8208 pixels $\times$ 256 stages; P2: 8208 pixels $\times$ 32 stages
Maximum line rate	500 kHz @ 8-bit, 428 kHz @ 10-bit, 380 kHz @ 12-bit
TDI stages	P1: 4, 32, 64, 128, 192, 224, 252, 256; P2: 2, 4, 8, 16, 24, 28, 30, 32
Operating mode	TDI, Area
Scan direction control	User control, trigger control
Conversion gain	0.21 e-/DN
System gain	5.12 e-/ADU
Dynamic range	66.9 dB
Read noise	8.22 e-
Full well charge	20.0 ke-
SNR	43.0 dB
Dark current	517 e-/s/pixel @ 10°C
Gain	Analog gain: $\times 1$ to $\times 4$; digital gain: $\times 0.1$ to $\times 16.0$
Binning mode	2×2 , 4×4 , 8×8
ROI	Supported
Data interface	QSFP+ / QSFP28
Cooling method	Air cooling, forced-air cooling, water cooling
External trigger mode	Line trigger, frame trigger, line + frame trigger
Digital I/O	Two 7-pin interfaces. Each interface provides four configurable input/output channels and one RS-485 differential interface.
General parameters	
Power supply	Powered by a 24 V power adapter
Power consumption	TBD
Temperature	Operating temperature: 0–40°C; storage temperature: -20–60°C
Humidity	20%–80%
Dimensions	120 mm $\times$ 120 mm $\times$ 144.5 mm
Weight	2 kg
Lens mount	M72 $\times$ 0.75
Software	ToupView, CLView software based on Delsa acquisition card, LabView, MATLAB, etc
SDK	C, C++, C#, Python
Operating system	Windows, Linux

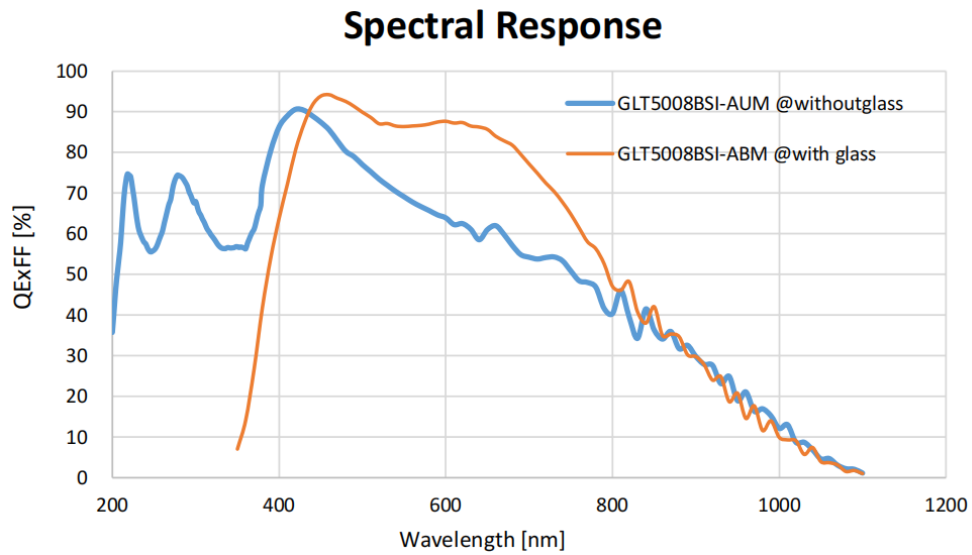


Figure 3.2-3 The spectral QE of GLT5008BSI

3.2.4 sTDI08KA-VIS-CoF1000K

Table 3-10 sTDI08KA-VIS-CoF1000K camera specifications

Parameter	Model
sTDI08KA-VIS-CoF1000K	
Camera	
Sensor model	Gpixel GLT5008BSI
Sensor type	BSI sCMOS TDI
Spectral range	300 nm–1100 nm
Charge transfer efficiency	≥ 0.99993
Pixel size	$5\ \mu\text{m} \times 5\ \mu\text{m}$
Color/Mono	Mono
Resolution	P1: 8208 pixels $\times$ 256 stages; P2: 8208 pixels $\times$ 32 stages
Maximum line rate	1000 kHz @ 8-bit/10-bit
TDI stages	P1: 4, 32, 64, 128, 192, 224, 252, 256; P2: 2, 4, 8, 16, 24, 28, 30, 32
Operating mode	TDI, Area
Scan direction control	User control, trigger control
Conversion gain	0.054 e-/DN
System gain	17.6 e-/ADU
Dynamic range	64.6 dB
Read noise	10.0 e-
Full well charge	17.0 ke-
SNR	42.3 dB
Dark current	517 e-/s/pixel @ 10°C
Gain	Analog gain: $\times 1$ to $\times 4$; digital gain: $\times 0.1$ to $\times 16.0$
Binning mode	2×2 , 4×4 , 8×8
ROI	Supported
Data interface	QSFP+ / QSFP28
Cooling method	Air cooling, forced-air cooling, water cooling
External trigger mode	Line trigger, frame trigger, line + frame trigger
Digital I/O	Two 7-pin interfaces. Each interface provides four configurable input/output channels and one RS-485 differential interface.
General parameters	
Power supply	Powered by a 24 V power adapter
Power consumption	TBD
Temperature	Operating temperature: 0–40°C; storage temperature: -20–60°C
Humidity	20%–80%
Dimensions	120 mm $\times$ 120 mm $\times$ 144.5 mm
Weight	2 kg
Lens mount	M72 $\times$ 0.75
Software	ToupView, CLView software based on Delsa acquisition card, LabView, MATLAB, etc
SDK	C, C++, C#, Python
Operating system	Windows, Linux

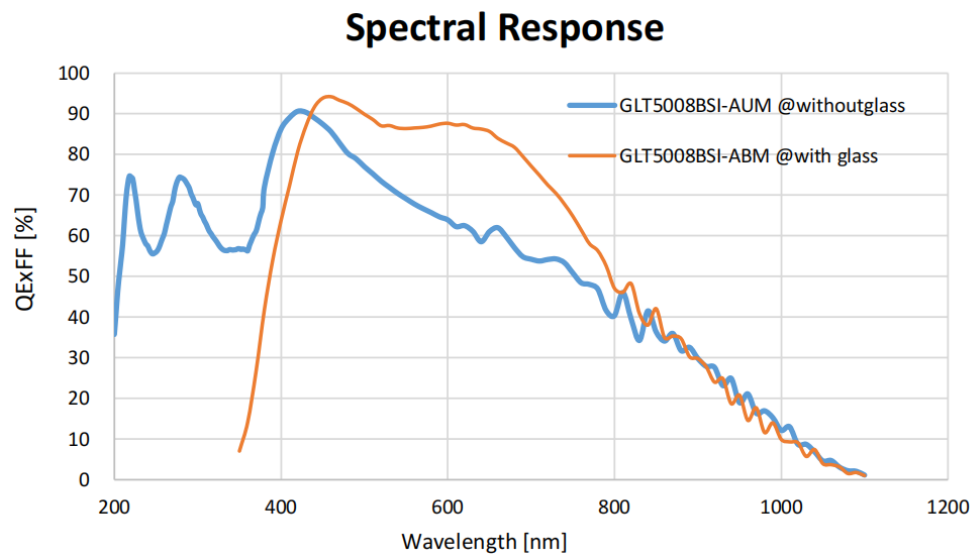


Figure 3.2-4 The spectral QE of GLT5008BSI

4 High Resolution Camera Specification (1)

4.1 SR600MMA

Table 4-1 SR600MMA camera specifications

Parameter	Model	SR600MMA
		Camera
Sensor model		VPS2163A
Sensor type		CMOS
Spectral range		300nm-1100nm
pixel size		0.5 μ m x 0.5 μ m
Target size		1.08''
Resolution		20480 x 27200
Inter-frame space		6s
Memory		512MB (4Gb)
Conversion gain		TBD
Dynamic Range		TBD
Read noise		TBD
Full well charge		TBD
SNR		TBD
Sensitivity		TBD
Dark current		TBD
QE		TBD
Exposure time range		TBD
Gain Range		TBD
Shutter mode		Rolling shutter
Binning mode		Software 2x2, 3x3, 4x4
Data interface		USB3.0
Digital I/O		TBD
Data Format		8bit / 10bit
Cooling temperature difference		Below room temperature 40 degrees Celsius
		General parameters
Power supply		DC19V 4.74A power supply
Power consumption		TBD
Temperature		Working temperature -30 ~ 45 °C, storage temperature - 40 ~ 60 °C
Humidity		0-95%
Size		TBD
Weight		TBD
Lens mount		TBD
Software		ToupView, CLView software based on Delsa acquisition card, LabView, MATLAB, etc
SDK		C, C++, C#, Python
Operating system		Windows, Linux

5 Camera Dimension and Interface

5.1 sMAX04BM

5.1.1 Mechanical Housing Dimensions

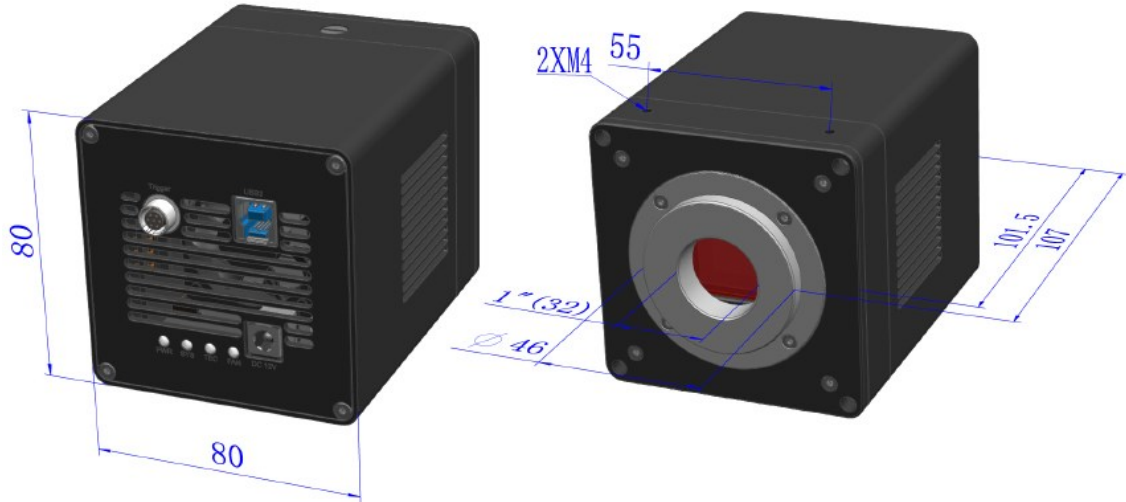


Figure 5.1-1 sMAX04BM & sMAX04BM-U100 dimensions (mm)

5.1.2 Interface Description

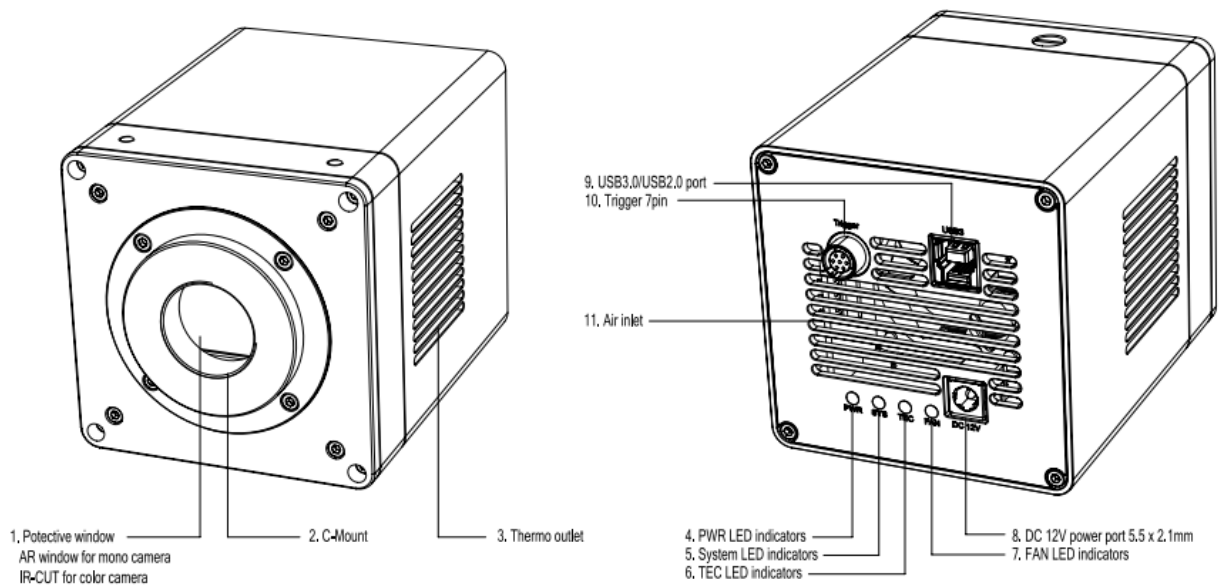


Figure 5.1-2 sMAX04BM & sMAX04BM-U100 Camera interface diagram

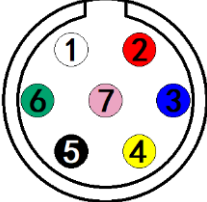
Table 5-1 sMAX04BM & sMAX04BM-U100 Camera interface definition

Item	Specification
1	Filter window, AR window for mono camera
2	C mount
3	Thermo outlet
4	Power LED indicators
5	System LED indicators
6	TEC LED indicators
7	FAN LED indicators

8	DC 12V power port
9	USB 3.0/ USB 2.0 port
10	Trigger 7PIN
11	Air inlet

5.1.3 Power Supply and I/O Connector

Table 5-2 sMAX04BM & sMAX04BM-U100 series pin signal definition

	Color	Pin	Signal	Signal description
	White	1	GND	Direct-coupled signal ground
	Red	2	12V	12VDC 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)

5.1.4 Packing Information

Table 5-3 Recommended accessories

Order number	Accessories name	Quantity	Instruction
1	Camera	1	Camera referred in this manual
2	Power adapter	1	Input: AC 100~240V 50Hz/60Hz,output: DC 12V 3A
3	I/O cable	1	7 Pin cable or extended cable
4	Cable	1	USB3.0 cable
5	Lens (optional)	1	C-mount lens

5.2 sMAX04BM-CL100

5.2.1 Mechanical Housing Dimensions

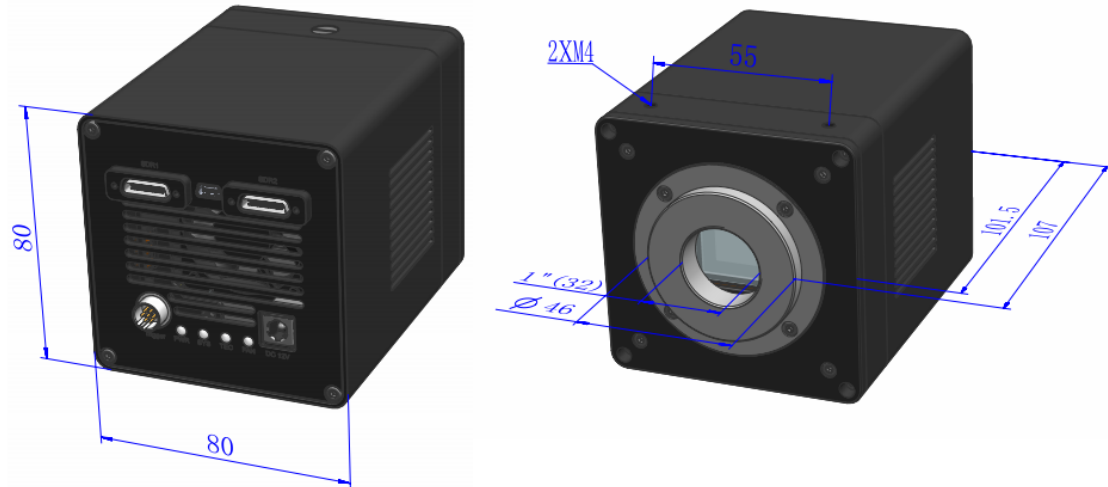


Figure 5.2-1 sMAX04BM-CL100 dimensions (mm)

5.2.2 Interface Description

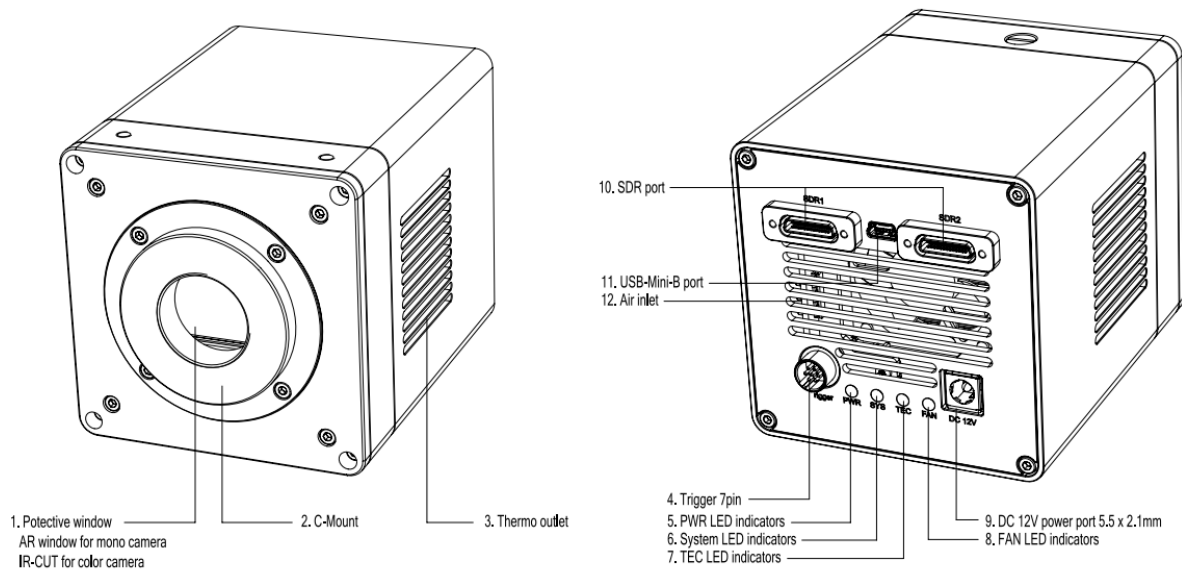


Figure 5.2-2 sMAX04BM-CL100 Camera interface diagram

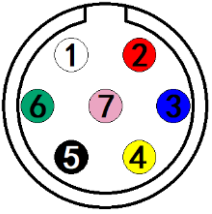
Table 5-4 sMAX04BM-CL100 Camera interface definition

Item	Specification
1	Filter window, AR window for mono camera
2	C mount
3	Thermo outlet
4	Trigger 7PIN
5	Power LED indicators
6	System LED indicators
7	TEC LED indicators
8	FAN LED indicators
9	DC 12V power port, 5.5 × 2.1mm

10	CameraLink port
11	USB-Mini-B port
12	Air inlet

5.2.3 Power Supply and I/O Connector

Table 5-5 sMAX04BM-CL100 series pin signal definition

	Color	Pin	Signal	Signal description
	White	1	GND	Direct-coupled signal ground
	Red	2	12V	12VDC 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)

5.2.4 Packing Information

Table 5-6 Recommended accessories

Order number	Accessories name	Quantity	Instruction
1	Camera	1	Camera referred in this manual
2	Power adapter	1	Input: AC 100~240V 50Hz/60Hz,output: DC 12V 3A
3	I/O cable	1	7 Pin cable or extended cable
4	Cable	1	CameraLink cable
5	Lens (optional)	1	C-mount lens

5.3 sMAX16AM & sMAX16BM

5.3.1 Mechanical Housing Dimensions

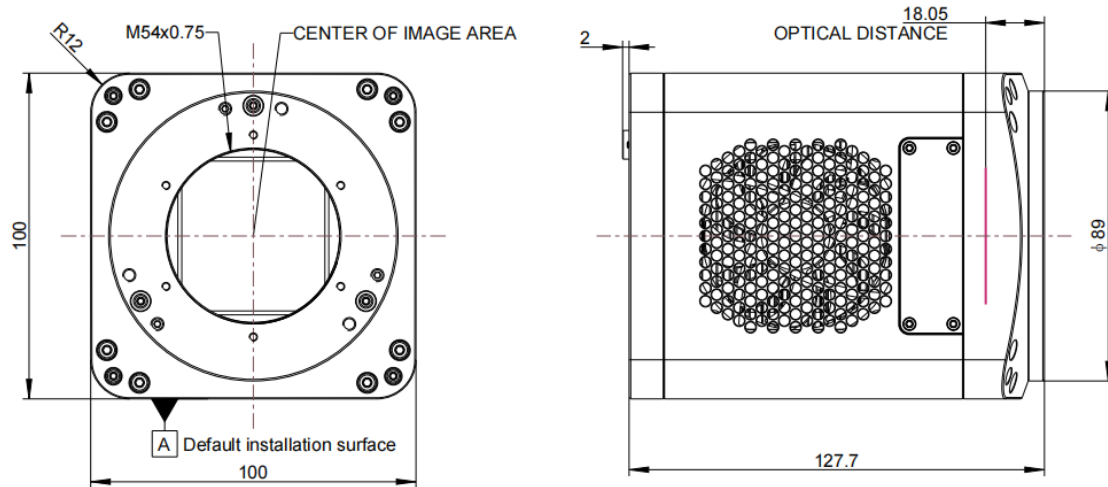


Figure 5.3-1 sMAX16AM & sMAX16BM dimensions (mm)

5.3.2 Interface Description

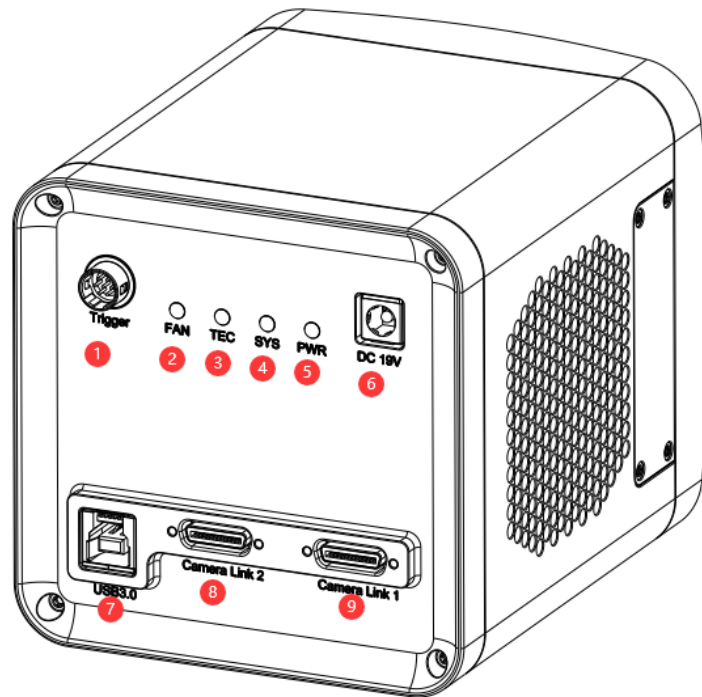


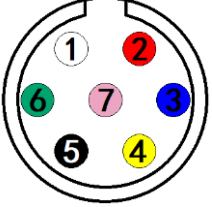
Figure 5.3-2 sMAX16AM & sMAX16BM Camera interface diagram

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

Table 5-7 sMAX16AM & sMAX16BM Camera interface definition

5.3.3 Power Supply and I/O Connector

Table 5-8 sMAX16AM & sMAX16BM 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)

5.3.4 Packing Information

Table 5-9 Recommended accessories

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

5.4 sCCD01AM

5.4.1 Mechanical Housing Dimensions

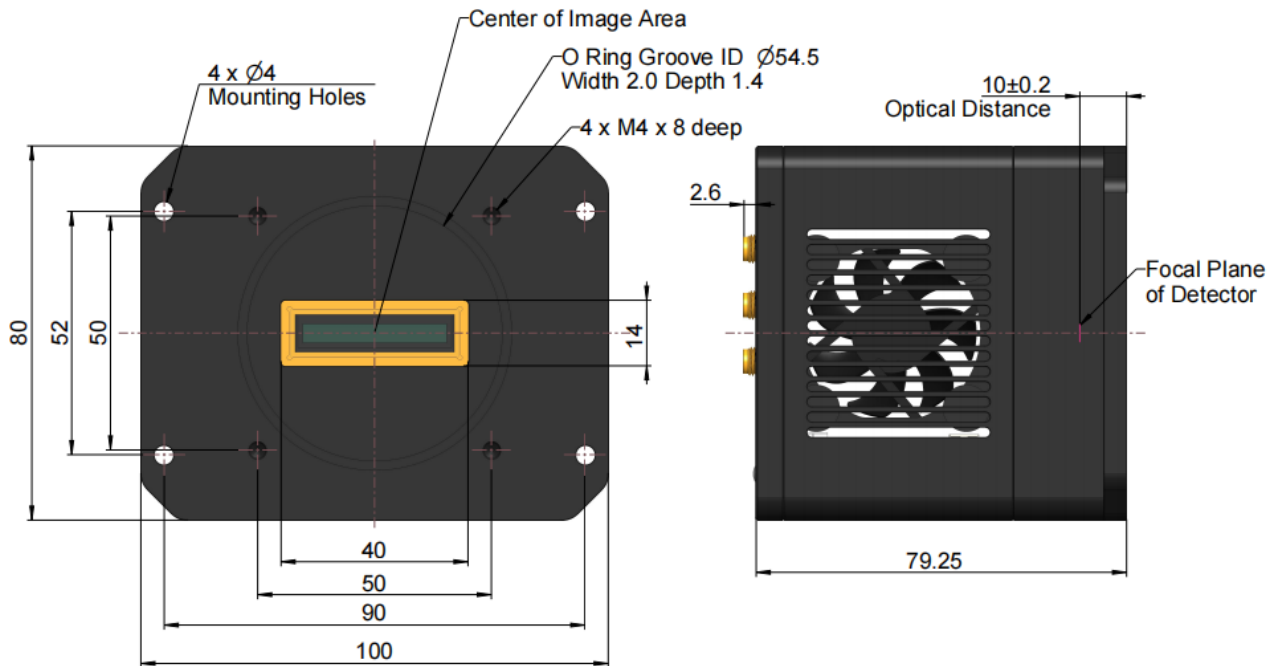


Figure 5.4-1 sCCD01AM dimensions (mm)

5.4.2 Interface Description



Figure 5.4-2 sCCD01AM Camera interface diagram

Item	Specification
1	DC 19V power port
2	USB 3.0 port
3	GigE port
4	
5	

6	
---	--

Table 5-10 sCCD01AM Camera interface definition

5.4.3 Power Supply and I/O Connector

5.4.4 Packing Information

Table 5-11 Recommended accessories

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

5.5 sTDI

5.5.1 Mechanical Housing Dimensions

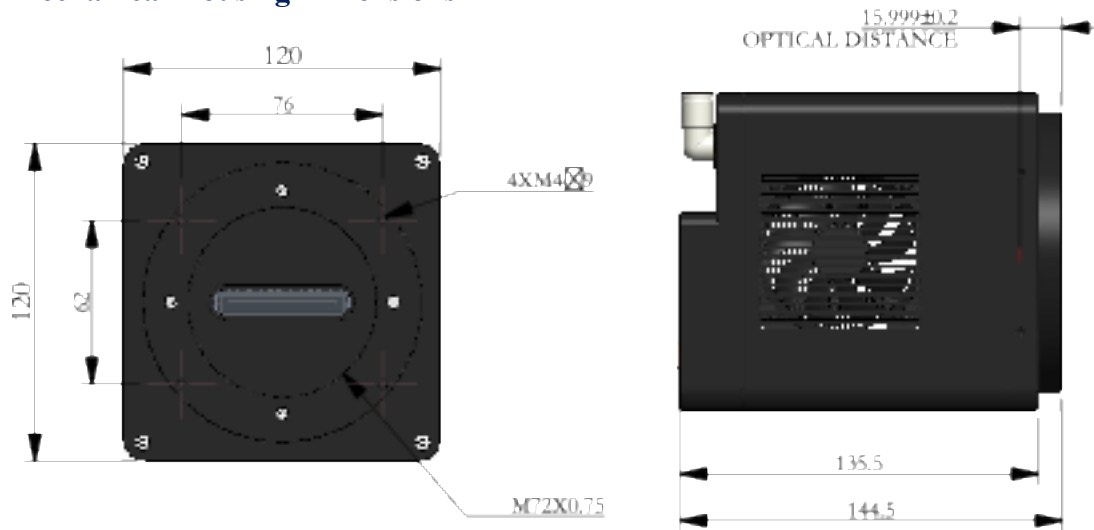


Figure 5.5-1 sTDI08KA dimensions (mm)

5.5.2 Interface Description

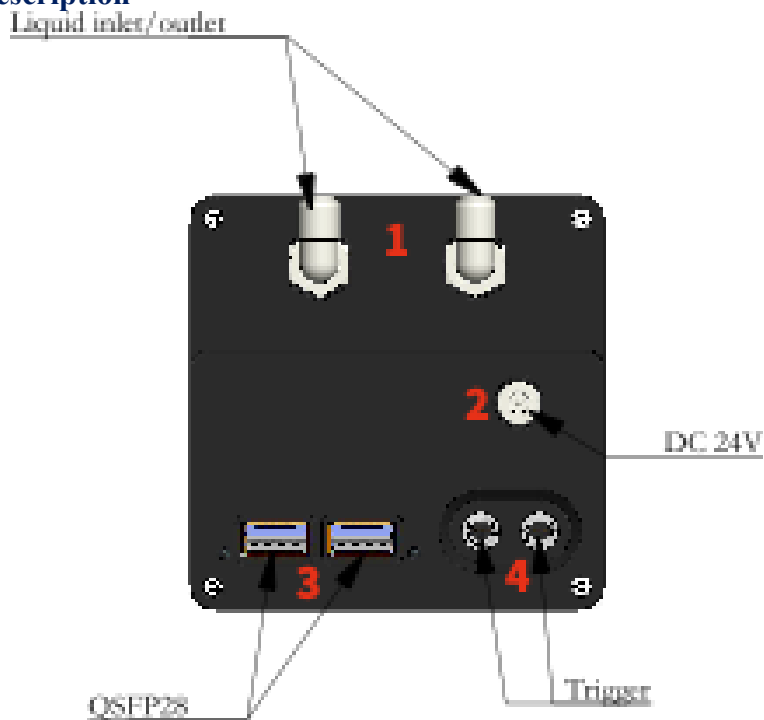


Figure 5.5-2 sTDI08KA Camera interface diagram

Item	Specification
1	Liquid cooling inlet/outlet ports
2	DC 24 V power input
3	QSFP28 high-speed data interface
4	7-pin external trigger and digital I/O interface

Table 5-12 sTDI08KA Camera interface definition

5.5.3 Power Supply and I/O Connector

5.5.4 Packing Information

Table 5-13 Recommended accessories

Order number	Accessories name	Quantity	Instruction
1	Camera	1	The camera described in this manual
2	Power adapter and power cord	1	Input: AC 100–240 V, 50/60 Hz; output: DC 19 V, 4 A
3	I/O cable	2	7-pin cable or extension cable
4	QSFP28 high-speed data cable	1	Used for data transmission between the camera and a high-speed image acquisition card or data processing device
5	Liquid cooling tubing and fittings	1 set	Used in water-cooling mode to connect the camera coolant inlet and outlet to an external cooling device
7	High-speed image acquisition card	1 (optional)	Must be compatible with the camera's QSFP28 data protocol. Standard inclusion depends on the actual sales configuration
8	Lens	1 (optional)	The camera uses an $M72 \times 0.75$ lens mount. Select the lens model according to the application requirements

6 Electrical Characteristics

6.1 7PIN I/ O Electrical Properties

6.1.1 Opto-isolated Input Circuit (line0)

In the camera I/O control, opto-isolated input circuit is shown in Figure 6.1-1.

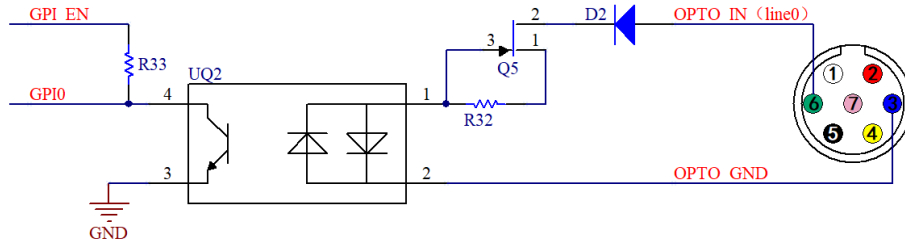


Figure 6.1-1 Opto-isolated input circuit

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.

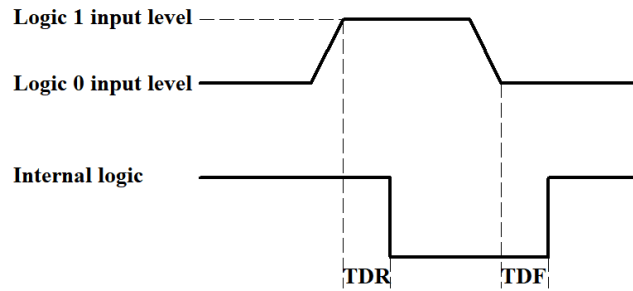


Figure 6.1-2 Input logic level

Input rise delay (TDR): 6us

Input drop delay (TDF): 6us

6.1.2 Opto-isolated Output Circuit (line1)

In camera I/O control, opto-isolated output circuit is shown in Figure 6.1-3.

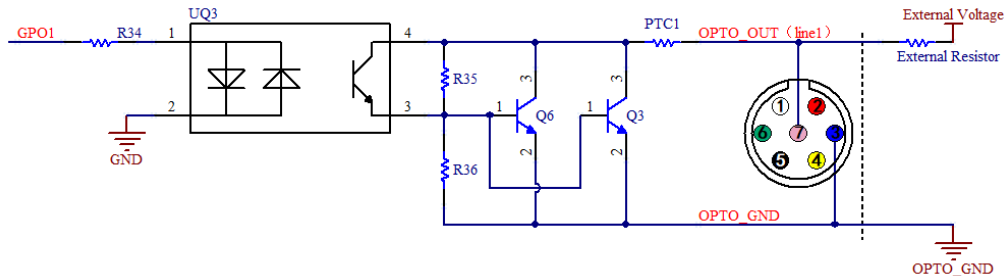


Figure 6.1-3 Opto-isolated output circuit

Opto-isolated output maximum current: 30mA

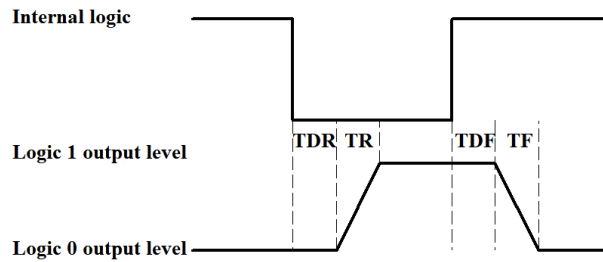


Figure 6.1-4 Output logic level

The electrical characteristics of the opto-isolated output signal (external voltage 5V, external resistor 1K) are shown in Table 6-1.

Table 6-1 Opto-isolated output signal's electrical characteristics

Parameter name	Parameter symbol	Parameter values
Output logic low level	VL	742mV
Output logic high	VH	4.134V
output rise time	TR	4us
Output downtime	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 Table 6-2 when different voltage and resistors are used in external circuit.

Table 6-2 Opto-isolated output logic's low level parameters

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

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

Non-isolated configurable input, output I/O circuit is shown in Figure 6.1-5, Figure 6.1-6.

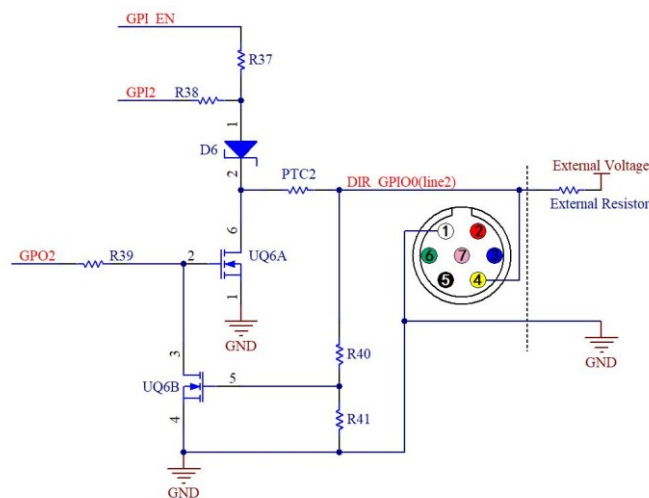


Figure 6.1-5 Non-isolated configurable input, output I/ O circuit (line2)

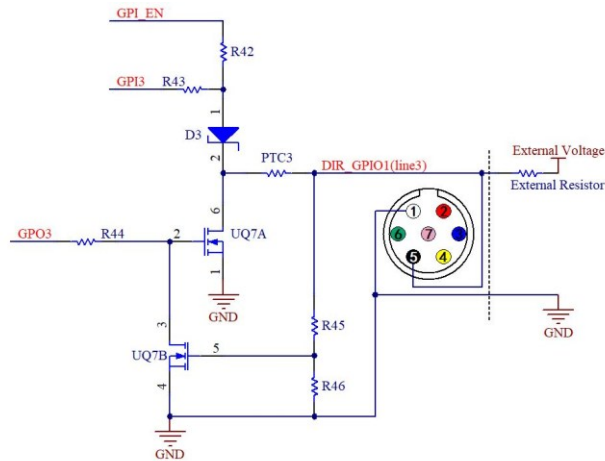


Figure 6.1-6 Non-isolated configurable input, output I/ O circuit (line3)

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.

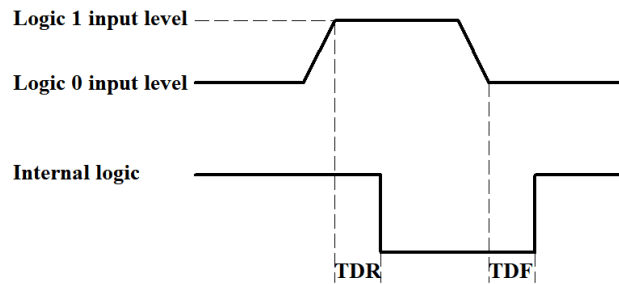


Figure 6.1-7 Input logic level

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, 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 Table 6-3.

Table 6-3 Non-isolated output logic's low level parameters

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 Figure 6.1-8.

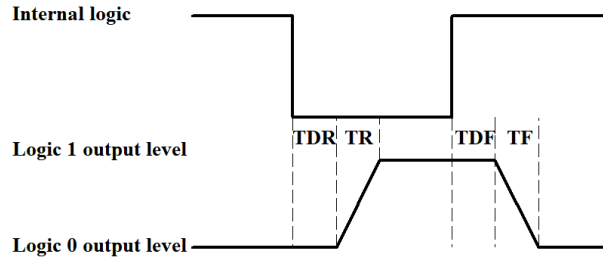


Figure 6.1-8 Output logic level

Table 6-4 Non-isolated output's electrical characteristics

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

6.2 6PIN I/ O Electrical Properties

6.2.1 Opto-isolated Input Circuit (line0)

In the camera I/O control, opto-isolated input circuit is shown in Figure 6.2-1.

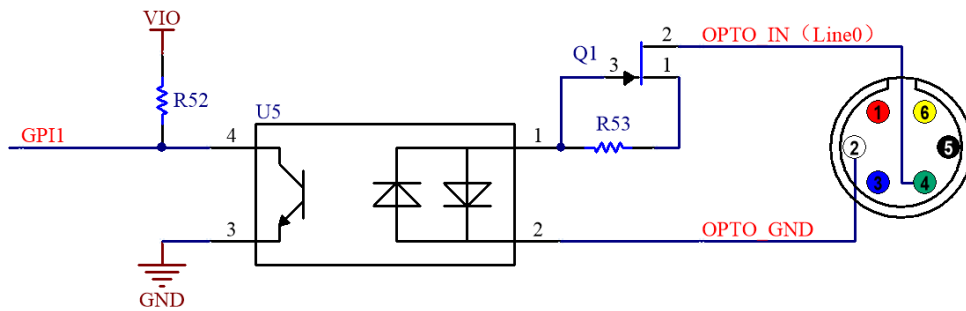


Figure 6.2-1 Opto-isolated input circuit

Logic 0 input level: 0~1.4VDC (OPTO_IN pin)

Logic 1 input level: 2.2~24VDC (OPTO_IN pin)

Maximum input current: 30mA

The input level is between 1.4V and 2.2V, the circuit action state is uncertain, please avoid the input voltage working in this range.

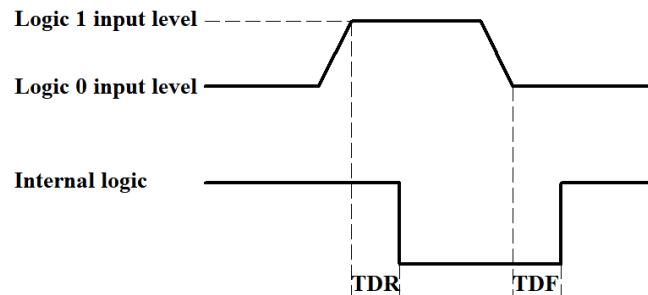


Figure 6.2-2 Input logic level

Input rise delay (TDR): 5us

Input drop delay (TDF): 25us

6.2.2 Opto-isolated Output Circuit (line1)

In camera I/O control, opto-isolated output circuit is shown in Figure 6.2-3.

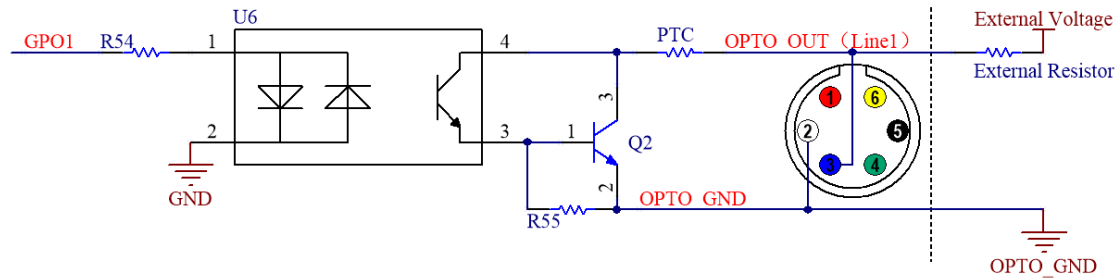


Figure 6.2-3 Opto-isolated output circuit

Opto-isolated output maximum current: 30mA

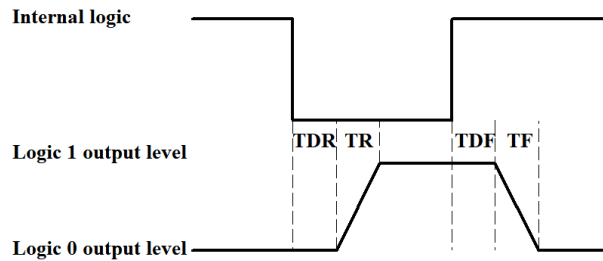


Figure 6.2-4 Output logic level

The electrical characteristics of the opto-isolated output signal (external voltage 5V, external resistor 1K) are shown in Table 6-5.

Table 6-5 Opto-isolated output signal's electrical characteristics

Parameter name	Parameter symbol	Parameter values
Output logic low level	VL	760mV
Output logic high	VH	5V
output rise time	TR	8.6us
Output downtime	TF	2.2us
Output rising delay	TDR	17.5us
Output drop delay	TDF	4.2us

The corresponding current and output logic low level parameters are shown in Table 6-6 when different voltage and resistors are used in external circuit.

Table 6-6 Opto-isolated output logic's low level parameters

External voltage	Non-essential resistance	VL	Output current
3.3V	1KΩ	668mV	2.82mA
5V	1KΩ	760mV	4.31mA
12V	2.4KΩ	798mV	4.68mA
24V	4.7KΩ	833mV	4.97mA

6.2.3 Input and Output I/O Circuit (line2/line3, applicable to V1.0 hardware version)

In camera I/O control with hardware version number V1.0, non-isolated input, output I/O circuit is shown in Figure 6.2-5.

1.3 MP 1" CMOS USB3.0 Industrial Camera

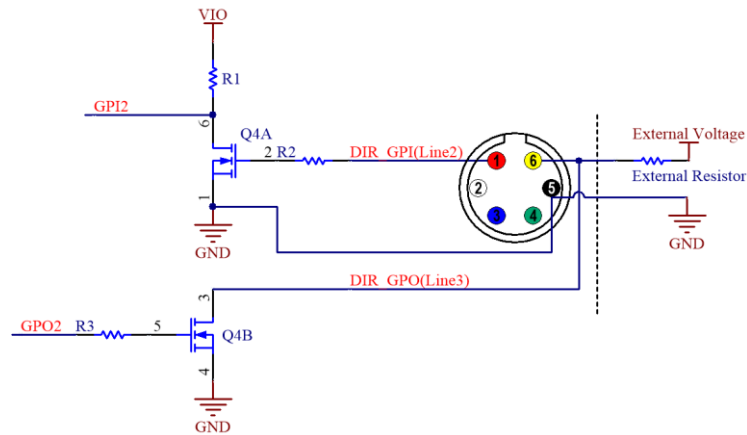


Figure 6.2-5 Non-isolated input, output I/ O circuit (line2)

1, GPI2 input level parameter:

Logic 0 input level: 0~0.9 VDC (DIR_GPI pin)

Logic 1 input level: 1~20VDC (DIR_GPI pin)

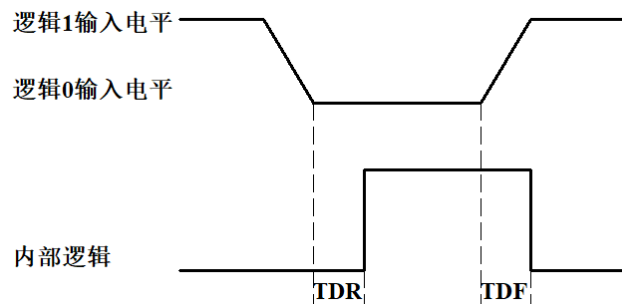


Figure 6.2-6 Input logic level

To prevent damage to the GPI pin, connect the GND pin before entering voltage to the DIR_GPI pin.

2, GPO2 output level parameter:

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 Table 6-7.

Table 6-7 Non-isolated output logic's low level parameters

External voltage	Non-essential resistance	VL (GPO2)
3.3V	1KΩ	0V
5V	1KΩ	0V
12V	2.4KΩ	0V
24V	4.7KΩ	0V

The external pull-up voltage 5V pull-up resistance 1K Ω, GPO2 output logic level, electrical characteristics are shown in Figure 6.2-7.

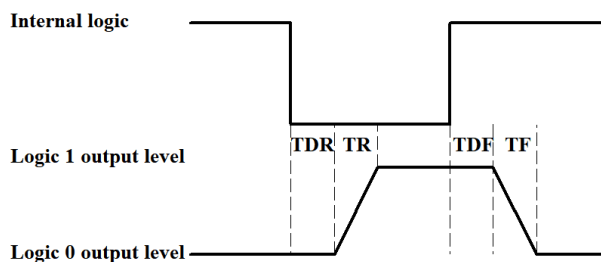


Figure 6.2-7 Output logic level

Table 6-8 Non-isolated output's electrical characteristics

Parameter name	Parameter symbol	Parameter values
Output rise time	TR	0.01us
Output downtime	TF	0.01us
Output rising delay	TDR	0.02us
Output drop delay	TDF	0.04us

6.2.4 Input and Output I/O Circuits (line2, the hardware version is V2.0 or later)

Camera with hardware version V2.0 and above, its input and output I/O circuits are shown in Figure 6.2-8.

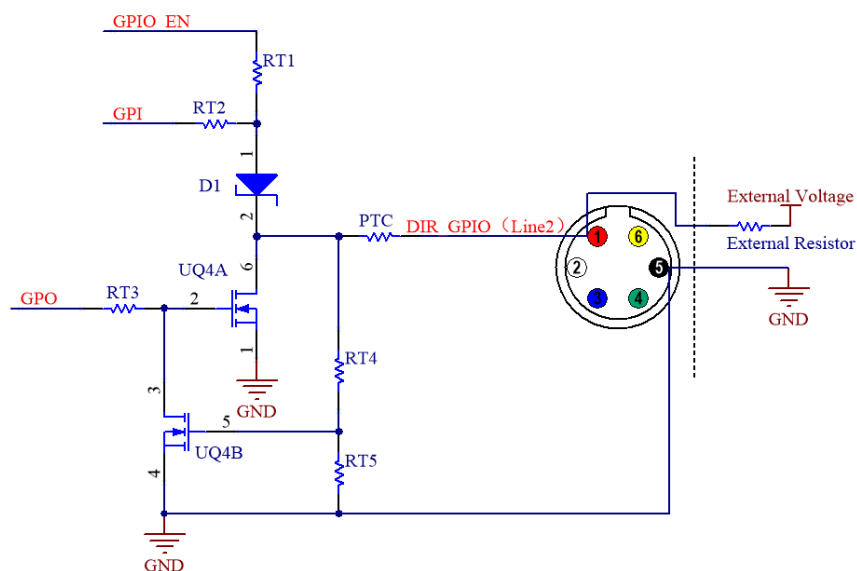


Figure 6.2-8 Non-isolated configurable input / output I/O circuits

Line2 is set as input pin

Logic 0 input level: 0~0.6VDC (DIR_GPIO pin)

Logic 1 input level: 2~24VDC (DIR_GPIO pin)

Maximum input current: 25mA

When the input level is between 0.6 V and 2 V, the circuit action is uncertain. Please avoid the input voltage working in this range.

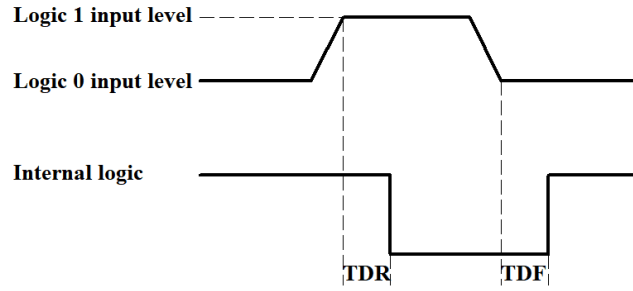


Figure 6.2-9 Input logic level

To prevent the GPIO pin from being damaged, first connect the ground pin GND and then input the voltage to the Line2 pin.

Input rise delay (TDR): 0.02us

Input drop delay (TDF): 0.02us

Line2 is 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 external voltage, resistance and output low level are shown in Table 6-9.

Table 6-9 Non-isolated output logic low level parameters

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

The external pull-up voltage is 5V, the pull-up resistance is 1K Ω , the GPIO is configured as the output logic level and the electrical characteristics are shown in Figure 6.2-10.

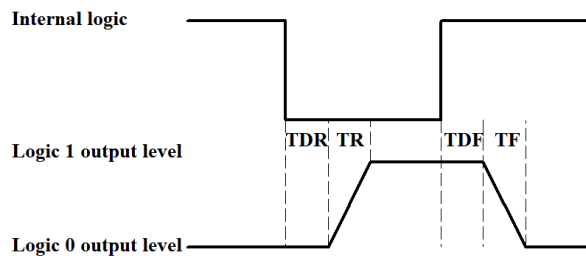


Figure 6.2-10 Output logic level

Table 6-10 Non-isolated output's electrical characteristics

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

7 Description of Functions

7.1 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).

7.2 ROI Control

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

7.3 Bandwidth and Precise Frame Rate Control

7.3.1 Bandwidth

Partial cameras supports bandwidth adjustment from 1% to 100%. As shown in Figure 7.3-1, the camera is @ 100% bandwidth by default, and you can drag the slider to set the desired bandwidth.

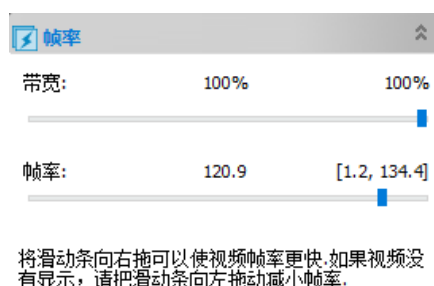


Figure 7.3-1 Bandwidth and precise frame rate settings

7.3.2 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 7.3-1, the current frame rate can be set by dragging the Bandwidth or Frame Rate slider bar left or right.

7.4 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.

7.5 Binning

Camera supports additive or averaged 1×1 to 8×8 digital binning, and averaged 1×1 to 2×2 hardware binning. Hardware binning can achieve higher frame rates than software binning.

7.6 Power Supply and Cooling System

MAX series adopts DC19V power supply, ITR3CMOS series and CTR3CMOS 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 ToupView. 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, ToupView can display the current temperature in real time, as shown in Figure 7.6-1.



Figure 7.6-1 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 7.6-2.



Figure 7.6-2 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

8 Filter

8.1 AR Version

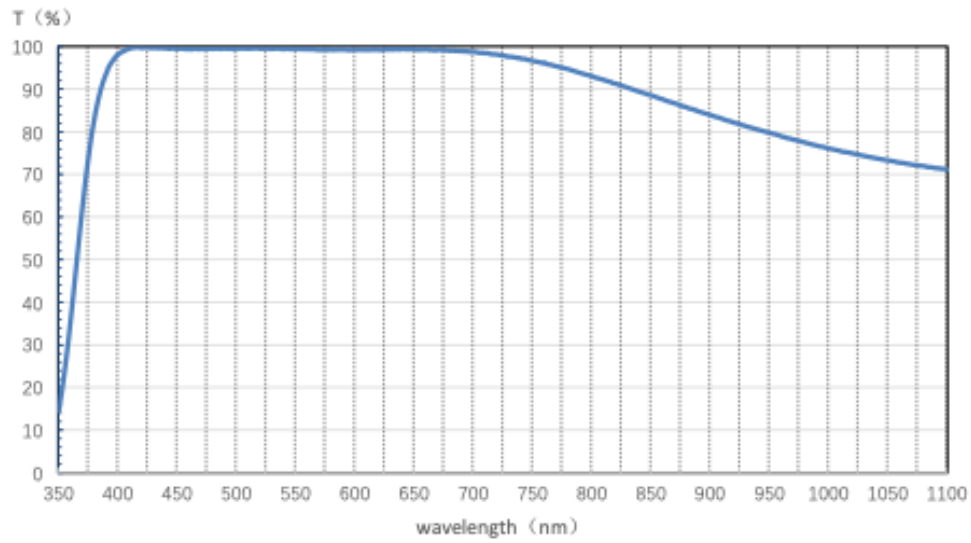


Figure 8.1-1 Transmittance curve

Table 8-1 Transmittance

λ 1 (nm)	T1 (%)	λ 2 (nm)	T2 (%)	λ 3 (nm)	T3 (%)	λ 4 (nm)	T4 (%)
350	14.58	570	99.15	790	93.85	1010	75.47
360	35.38	580	99.21	800	93.04	1020	74.9
370	61.78	590	99.26	810	92.23	1030	74.33
380	82.87	600	99.28	820	91.33	1040	73.79
390	93.54	574	99.28	794	90.39	1014	73.27
400	98.02	584	99.2	804	89.42	1024	72.78
410	99.5	594	99.34	814	88.56	1034	72.31
420	99.66	604	99.38	824	87.62	1044	71.96
430	99.72	578	99.34	798	86.67	1018	71.5
440	99.55	660	99.29	880	85.73	1100	71.07
450	99.46	670	99.21	890	84.8		
460	99.41	680	99	900	83.91		
470	99.42	690	98.94	910	83.06		
480	99.47	700	98.7	920	82.13		
490	99.5	710	98.43	930	81.34		
500	99.51	720	98.11	940	80.53		
510	99.53	730	97.66	950	79.77		
520	99.49	740	97.22	960	78.94		
530	99.5	750	96.59	970	78.16		
540	99.42	760	96.24	980	77.44		
550	99.41	770	95.4	990	76.77		
560	99.38	780	94.68	1000	76.05		

8.2 UV Version

The transmittance curve for the Quartz glass JGS2 filter used in UV series cameras (e.g., sMAX04BM) is shown in the figure below.

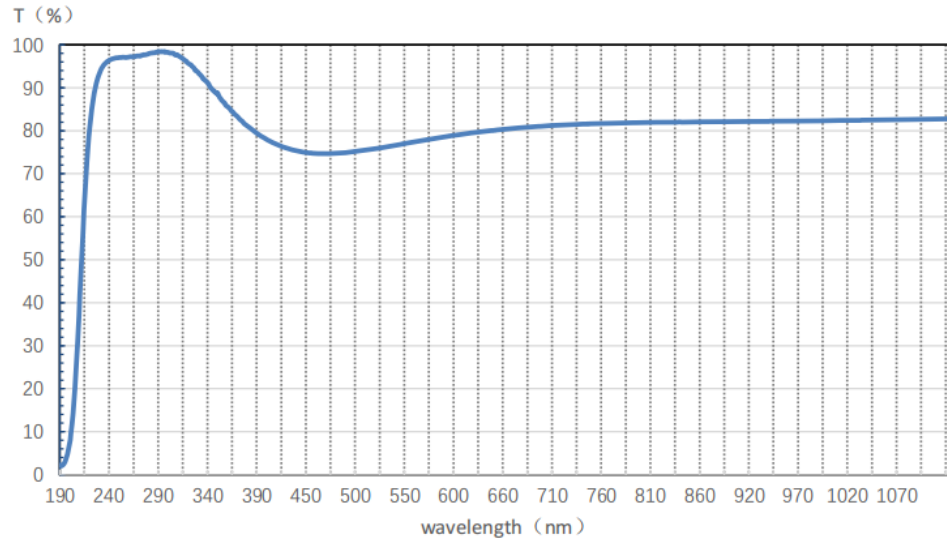


Figure 8.2-1 Transmittance curve

Table 8-2 Transmittance

λ (nm)	T (%)	λ (nm)	T (%)	λ (nm)	T (%)	λ (nm)	T (%)
190	2.28	420	75.91	650	80.51	880	82.14
200	8.01	430	75.34	660	80.73	890	82.15
210	41.85	440	74.92	670	80.91	900	82.17
220	80.82	450	74.71	680	81.07	910	82.18
230	93.45	460	74.65	690	81.17	920	82.20
240	96.42	470	74.73	700	81.33	930	82.23
250	97.01	480	74.91	710	81.43	940	82.27
260	97.12	490	75.16	720	81.55	950	82.28
270	97.40	500	75.44	730	81.61	960	82.28
280	97.92	510	75.80	740	81.67	970	82.34
290	98.40	520	76.18	750	81.74	980	82.37
300	98.19	530	76.58	760	81.76	990	82.39
310	97.43	540	77.01	770	81.84	1000	82.42
320	95.71	550	77.43	780	81.90	1010	82.45
330	93.57	560	77.79	790	81.91	1020	82.49
340	91.11	570	78.18	800	81.96	1030	82.51
350	88.78	580	78.57	810	81.99	1040	82.55
360	85.62	590	78.91	820	82.01	1050	82.60
370	83.27	600	79.25	830	82.05	1060	82.63
380	81.11	610	79.55	840	82.04	1070	82.68
390	79.34	620	79.82	850	82.08	1080	82.73
400	77.94	630	80.06	860	82.09	1090	82.76
410	76.84	640	80.36	870	82.11	1100	82.77

9 Trigger Mode and its Configuration

9.1 Video Mode and Trigger Mode

The trigger function can be found on the **Capture & Resolution** group on the **Camera Sidebar** in ToupView. When the camera is opened, it is in **Video Mode** as shown in Figure 9.1-1 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.

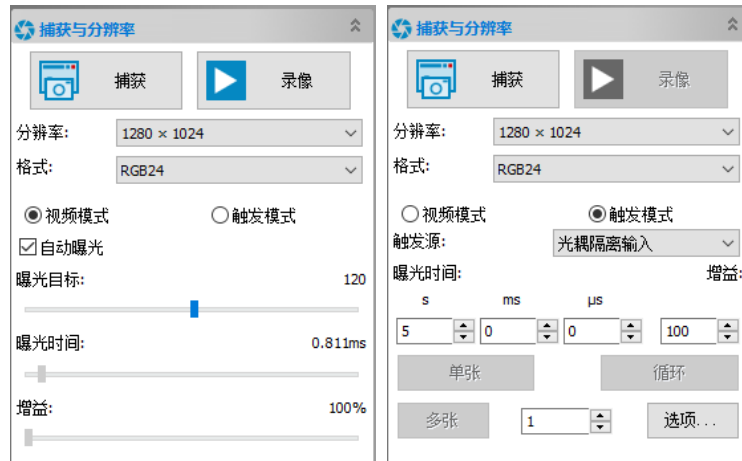


Figure 9.1-1 Video Mode and Trigger Mode on the Capture & Resolution group in ToupView

After the **Trigger Mode** is checked, the **Capture & Resolution** group will switch to **Trigger Mode** as shown in Figure 9.1-1 on the right. Where, the **Trigger Source**, **Exposure Time**, **Gain**, **Single**, **Loop**, **Multiple**, **Frame Box**, and **Options** can be set.

9.2 Trigger Sources and Their Capture Style

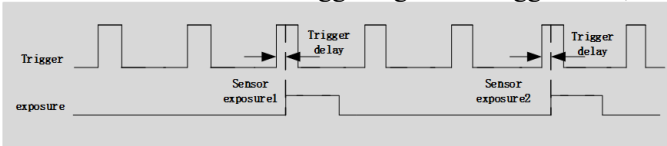
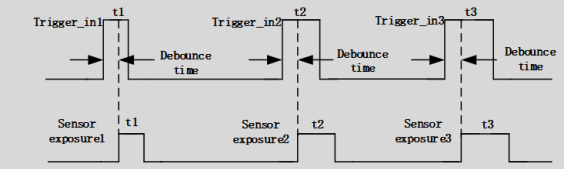
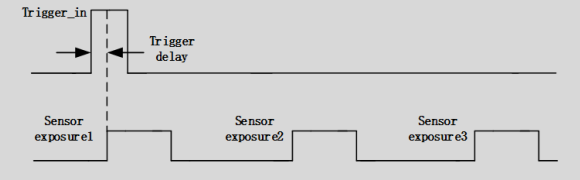
The **Trigger Source** can be any external input signal inputted into the camera which is called **Hardware (Trigger Source)**, it can also be a command from the application which is called **Software (Trigger Source)**. For the **Software Trigger Source**, it can be **Single**, **Loop**, **Multiple**, or **Sequence** style. Figure 9.2-1 shows the possible **Trigger Sources**. Table 9-1 shows the designed **Trigger Source** descriptions and possible capture styles for ToupTek camera.



Figure 9.2-1 Possible Trigger Sources

Table 9-1 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 configured 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 configured 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 () 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 ToupView, 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 (多张 3 选项...) 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;

9.3 The trigger capture and IO Control configurations

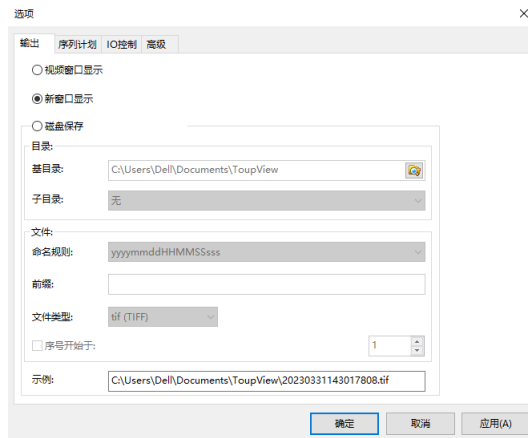


Figure 9.3-1 Options>Output page

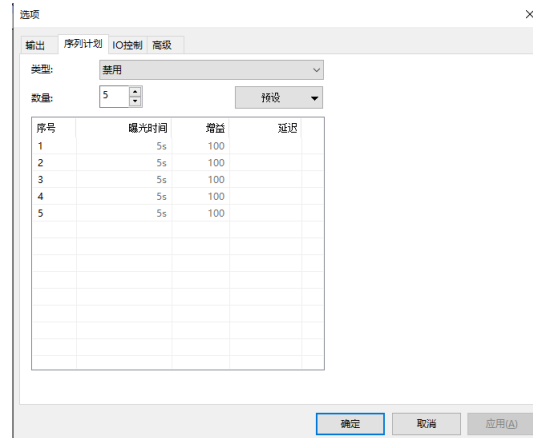


Figure 9.3-2 Options>Sequence page



Figure 9.3-3 Options>IO Control page

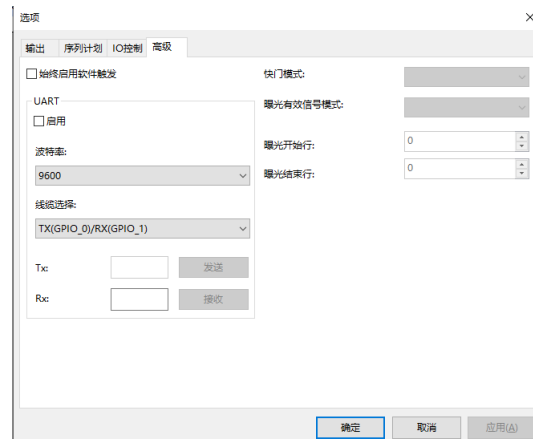


Figure 9.3-4 Options>Advanced page

The **Trigger Source** can be **Isolated input**, **GPIO0**, **GPIO1** (when configured as input), **Counter**, or **PWM** which can be configured on the **Options** property sheet. Also the camera's **Isolated output**, **GPIO0** or **GPIO1** (can be configured 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 9-2 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;

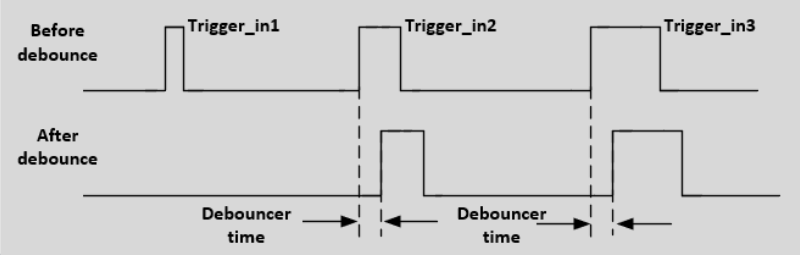
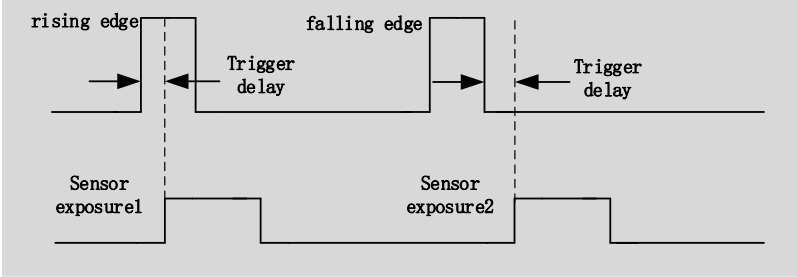
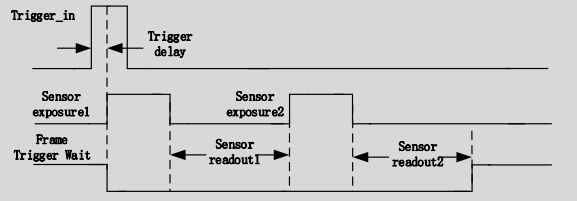
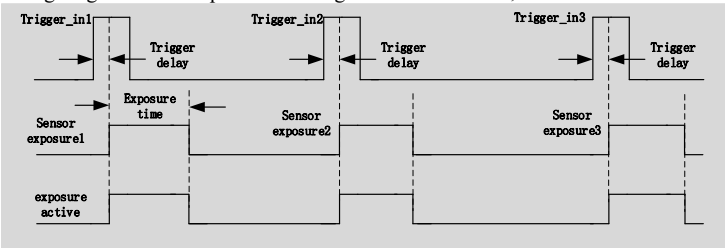
About the camera pin **IO Control** style, one can find it on the **Options>IO Control** page;

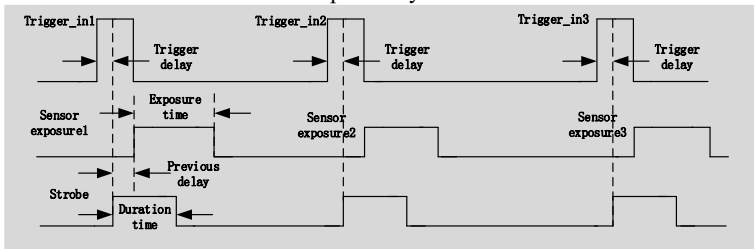
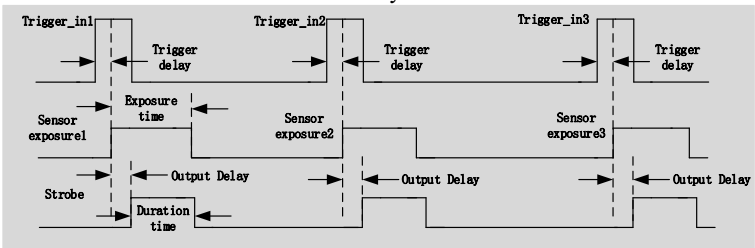
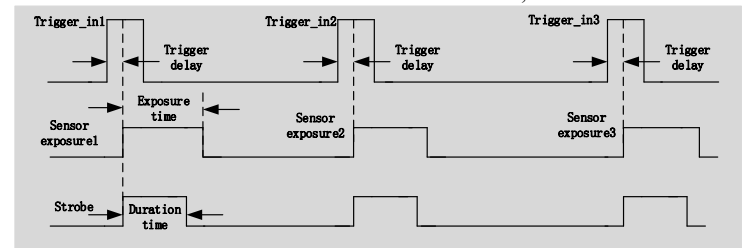
About the **Always enable software trigger** and **UART** setup, **Shutter Mode**, and **Exposure Active Mode**, one can find it on the **Options>Advance** page.

Table 9-2 Options property sheet for Trigger Source or camera pin configuration

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

page		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: 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 Debouncer 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;	触发等待信号 曝光有效信号 闪光灯信号 用户输出信号 计数器输出信号 定时器输出信号

		LSB UserOutput Value: 1 0 0 Line: line3 line2 line1 When the Counter Output is selected, when the counter value is “m”, the camera triggers “m” times to output a signal. When the Timer Output is selected, 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. LSB UserOutput Value: 1 0 0 Line: line3 line2 line1
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 9-1 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;

10 Application

10.1 Application installation

In terms of software, customers are welcome to visit our website: <https://toupstekphotonics.com/download/> to download the latest ToupView, 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.

10.2 Introduction to ToupView

ToupView is a professional software that integrates camera control, image acquisition and processing, image browsing and analysis functions. ToupView 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

10.2.1 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

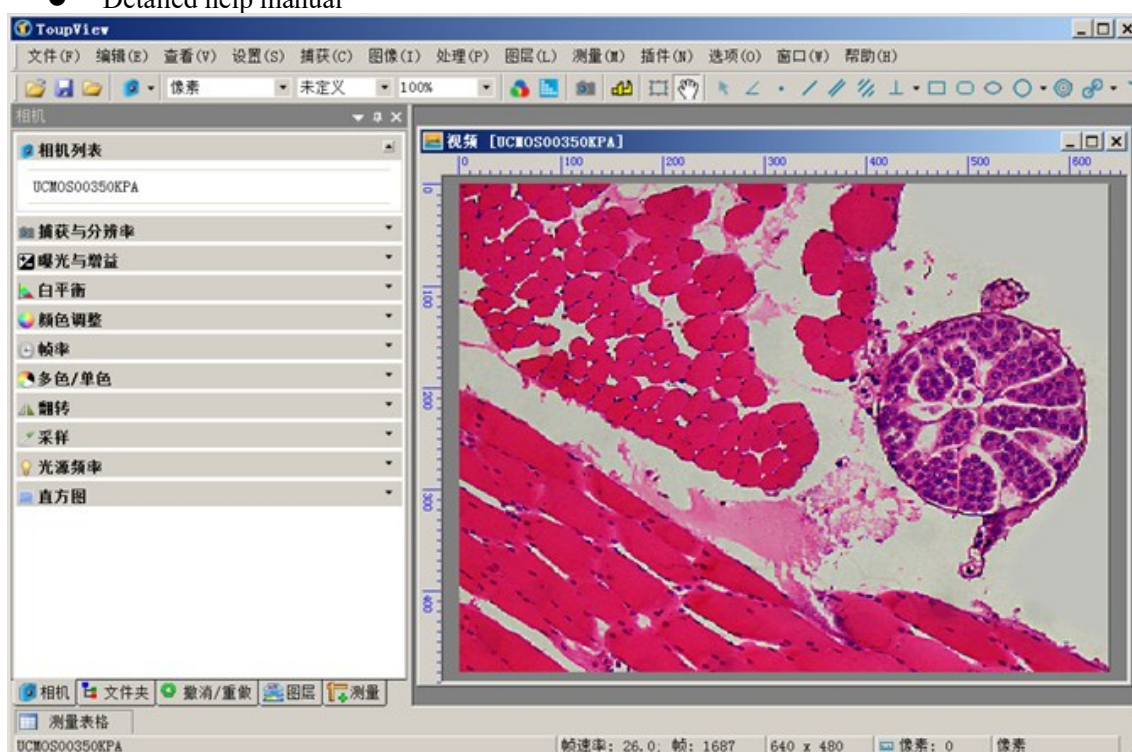


Figure 10.2-1 ToupView video window

10.2.2 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.)

10.2.3 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 ToupView 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

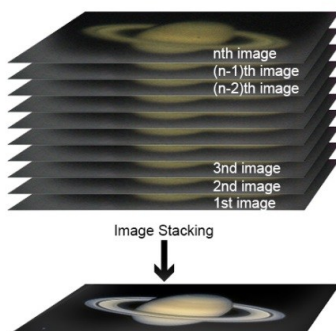


Figure 10.2-2 Image overlay denoising

10.2.4 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

10.2.5 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

11 Software development instructions

11.1 SDK description

The download link of the SDK is as follows:

<https://www.touptekphotonics.com.cn/download/?dlID=6>

11.1.1 SDK support platform

- Windows 32-bit:
 - x86: Windows XP SP3 and above; the CPU needs to support at least the SSE2 instruction set.
 - x64: Windows 7 and above.
 - ARM: Windows 10 and above.
 - ARM64: Windows 10 and above.
- Windows RT: x86, x64, ARM, ARM64; Windows 10 and above.
- macOS: Universal (x64 + x86); macOS 10.10 and above.
- Linu: 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-gnueabi (version 4.9.2).
 - arm64: glibc 2.17 and above; compiled by toolchain aarch64-linux-gnu (version 4.9.2).
- Android:
 - ARM: armeabi-v7a
 - ARM64: arm64-v8a
 - x86: x86
 - x64: x86_64
 - compiled by Android NDK r18b.

11.1.2 Introduction to SDK content

ToupCam 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:
 - toupcam.h, the C/C++ header file.
- win: Microsoft Windows platform file
 - ◆ dotnet:
 - toupcam.cs, supports C#. toupcam.cs uses P/Invoke to call toupcam.dll. Please copy toupcam.cs to your C# project for use.
 - toupcam.vb, supports VB.NET. toupcam.vb uses P/Invoke to call toupcam.dll. Please copy toupcam.vb to your VB.NET project for use.
 - ◆ x86:
 - toupcam.lib, x86 lib file.
 - toupcam.dll, x86 dynamic library file.
 - democpp.exe, x86 C++ demo execute the procedure.
- x64:
 - toupcam.lib, x64 lib file.

toupcam.dll, x64 dynamic library file.

democpp.exe, x64 C++ demo execute the procedure.

- arm:
toupcam.lib, arm lib file.
toupcam.dll, arm dynamic library file.
- arm64:
toupcam.lib, arm64 lib file.
toupcam.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 toupcam.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 toupcam.cat, toupcam.inf and toupcam.sys.
The x64 folder contains the x64 kernel-mode driver files, including toupcam.cat, toupcam.inf and toupcam.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.), w mV 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. demowinforms1, 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. demowinforms2, 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. demowinforms3, 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. demowinfor mVb, 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-toupcam.rules, udev rule file.
Please refer to: http://reactivated.net/writing_udev_rules.html.
- c#: toupcam.cs, Support. Net Core C#. toupcam.cs uses P/Invoke to call libtoupcam.so. Please copy

- toupcam.cs to your C# project for use.
- x86: libtoupcam.so, x86 version so file.
- x64: libtoupcam.so, x64 version so file.
- armel: libtoupcam.so, armel version so file, toolchain is arm-linux-gnueabi.
- armhf: libtoupcam.so, armhf version so file, toolchain is arm-linux-gnueabi.
- arm64: libtoupcam.so, arm64 version so file, toolchain is aarch64-linux-gnu.
- android: libtoupcam.so for four architectures of Android platform arm, arm64, x86, x64.
- mac: macOS platform files.
- python: toupcam.py and example code.
- java: toupcam.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.

12 ToupTek®-- Contact Information

For the latest ToupView, please visit our website (touptekphotonics.com) and download the newest version.

	杭州图谱光电科技有限公司	
	杭州市西湖区西园五路 6 号奥强大厦 1 号楼 15 层	
	杭州, 310030, 浙江,	
	中国	
	Hangzhou ToupTek Photonics Co., Ltd	
	15F, Aoqiang Building 1, No. 6, Xiyuan 5th Rd.,	
	Hangzhou, 310030, Zhejiang,	
	P.R.China	
	+86-571-8111-0735	
	+86-571-8111-0730	
	+86-571-8810-2638,	
	+86-18058780750 (手机/Mobile Phone)	
	FAX: +86-571-8668-3738	
	tphz@touptek.com	
	Skype:	18058780750/ToupTek Photonics
	Q Q	2426878316
	Wechat	18058780750

13 ToupTek Optoelectronics Website

13.1 Astronomy Official Website/web

中文: <https://www.touptekphotonics.com.cn>

English: <https://www.touptek.com>

English: <https://www.touptekphotonics.com>

13.2 Astronomy Independent Store/shop

中文: <https://www.touptek-astro.com.cn>

中文: <https://www.touptek-astro.cn>

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