SWIR331 Short-Wavelength Infrared Camera Help Manual

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8.1 SDK	
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1 The basic characteristics of the SWIR331 series camera

SWIR331 Short-Wavelength Infrared Camera is a C-mount short-wave infrared cooling camera using a nationally produced 640 x 512 InGaAs image sensor, which have CameraLink / USB3 (under development) / 10GigE (under development) and other data transmission methods. It has the advantages of 900 - 1700nm short-wave infrared wide spectral response, 330,000 resolution, high quantum efficiency and low noise.

SWIR331 Short-Wavelength Infrared Camera can be widely used in short-wave infrared imaging, spectral imaging, monitoring (night vision), semiconductor detection, medicine and biology, optical fiber communication, astronomy, high temperature imaging, humidity distribution imaging and other applications.





Figure 1 Front and back views of SWIR331 series cameras

The basic characteristics of SWIR331 Short-Wavelength Infrared Camera are listed below:

- 724FPS high frame rate
- InGaAs SWIR Detector
- 640 x 512
- 15um pixel size
- 900nm-1700nm
- Global shutter
- Built-in TEC refrigeration chip, the temperature difference can reach 45 degrees Celsius below the ambient temperature
- PID precise temperature control, the fluctuation is less than 0.3 degrees
- CameraLink Full / USB3 (under development) / 10GigE (under development)
- 12-bit output (14-bit ADC)
- Multiple working modes: video mode/soft trigger mode/external trigger mode
- There are 100% domestically produced device versions or high-performance versions
- Support field update firmware
- Accept OEM custom development

2 Camera parameters and performance

2.1 Brief list of SWIR331 camera simple parameter

Order Code	Sensor type and size	Pixel size(um)	Data Interface	Camera Type	FPS/Resolution	Exposure Time
SWIR331KMA-CL500				China produced devices	517@640x512	31.25us~1s
SWIR331KMA-CL700	0.33M / 640x512 - 3/4" (9.60x7.68) 15x15 Buit-in TEC	15,15	Comorolink	China produced devices	724@640x512	23.81us ~1s
SWIR331KMB-CL500		CameraLink	Global procurement of key chips	517@640x512	31.25us~1s	
SWIR331KMB-CL700				Global procurement of key chips	724@640x512	23.81us ~1s

2.2 SWIR331 Camera Specification

Table 1 SWIR331	camera	specification
-----------------	--------	---------------

Model	SWIR331KMA -CL500	SWIR331KMA-CL700	SWIR331KM B-CL500	SWIR331KM B-CL700	
Parameter		330,000 pixels 3/4" InGaAs Ca	meraLink Camera		
		Camera			
Sensor model	National production				
Sensor type	InGaAs CMOS image sensor				
Spectral range	900nm - 1700nm				
pixel size	15 μm x 15 μm				
Target size	3/4"				
ADC	12-bit output /14-bit output (14	4-bit ADC)			
Frame Rate & Resolution	517 fps @ 640 x 512	724 fps@640 x 512	517 fps @ 640 x 512	724 fps@640 x 512	
Memory	512MB				
QE	75%@ 1350nm				
Conversion gain	970.01e-/DN(LG), 18.02e-/DN(I	MG), 3.31e-/DN (HG)			
Dynamic Range	69.2dB(LG), 63.2dB(MG), 57.4d	B(HG) *1			
Read noise1.3DN(LG), 2.7DN(MG), 5.0DN(HG)					
Full well charge 3.5Me(LG), 70Ke(MG), 12Ke(HG) *1					
Maximum SNR	65.4dB(LG), 48.5dB(MG), 40.7d	B(HG)			
Dark current	30fa@0.1V&18℃				
Exposure time range	31.25us~1s	23.81us~1s	31.25us~1s	23.81us~1s	
Shutter mode	Global shutter				
Data interface	CameraLink Full				
Digital I/O	1 optocoupler isolated input, 1	optocoupler isolated output			
Data Format	Mono 12 / Mono 14				
Cooling temperature difference	Below room temperature 40 de	egrees Celsius			
Camera type	Nationally produced devices	Nationally produced devices	High performance	High performance	
		General parameters			
Power supply	DC12V power supply				
Power consumption	8.4W (TEC OFF) / <16W (TEC O	N)			
Temperature	TemperatureWorking temperature - 30 \sim 60 $^{\circ}$ C, storage temperature - 40 \sim 85 $^{\circ}$ C				
Humidity	20%-80% , non-condensing				
Size	68mm×68mm×90.3mm				
Weight	485g				
Lens mount	C-mount interface				
Software	Provide SDK development kit a	nd CL View software based on De	elsa acquisition card		

*1: LG: CDS-OFF, DeNoise-ON; MG: CDS-ON, DeNoise-OFF; HG: CDS-ON, DeNoise-OFF.

2.3 Sensor Quantum Efficiency



Figure 2 The spectral QE of SWIR331 Short-Wavelength Infrared Camera

2.4 Frame rate and ROI frame rate

The camera supports hardware ROI, the smaller the ROI size, the faster the frame rate

Table 2 CL700 ROI typical frame rate

X Size	Y Size	FPS
640	512	724
640	256	1432
320	256	2201
200	200	3487
120	120	6595

Table 3 CL500 ROI typical frame rate

X Size	Y Size	FPS
640	512	517
640	256	1023
320	256	1572
200	200	2491
120	120	4774

3 The main features of the SWIR331 series camera

Function	Function description
Operating mode	Operating mode: video mode or trigger mode
Operating mode	Trigger mode: soft trigger mode or external trigger mode
GenICam	Supports the standard GenICam protocol and can control the camera through third-party software
Serial port control	Support the virtual serial port of the CameraLink capture card to control the camera, and the camera command is open
Denoise	The camera hardware incorporates denoise
Bit depth	Built-in 14bit ADC, output 12bit or 14bit valid data
Automatic exposure	Automatic exposure or manual exposure function
Gain	HG, MG, LG 3 gain modes
Frame rate	Supports precise frame rate control
ROI	Supports single-zone ROI with a maximum frame rate of 8000fps after ROI
Flip	Supports Vertical/horizontal flip
Custom dark field correction	The hardware supports up to 12 groups of user-defined dark field correction image functions
Timestern function	Timestamps can be turned on or off. After the timestamp function is enabled, the low 8bits of 1-8 pixels, 9-16 pixels, and
Timestamp Tunction	17-24 pixels will be modified to: 0-7: frame number; 8-15: Frame time; 16-23: trigger signal count
Firmware update	Supports firmware online update
Pipette function	Supports the display of the gray value of the mouse pixel position
Histogram display	Supports histogram display and statistics
Plane line function	Supports the function of viewing surface data
Regional gray statistics	Support the average gray statistics function of user-defined areas
	1) When the DC12V power supply is disconnected and only the CameraLink cable is connected, the camera cannot work; 2) Connect the 6PIN aviation plug interface of the DC12V adapter to the DC12V interface on the camera. After the power is successfully turned on, the two LED lights will light up;
DC12V power supply and	3) The cooling system of the camera is divided into TEC cooling sheets built in the sensor, using external heat dissipation
cooling system	structure and fan auxiliary heat dissipation, the working temperature can be adjusted to a specific value, the effective
cooning system	cooling temperature can be lower than the ambient temperature of 40°C, and the high-efficiency cooling system ensures extremely low dark current level:
	4) The FEC system adopts PID algorithm control, so that TEC can accurately adjust the sensor to the target temperature.
	and the temperature deviation is 0.3°C;
	Support mainstream brand CameraLink capture card, through the virtual serial port control, there are two ways:
Acquisition card adaptation	1) The standard GenlCam protocol is used to control the acquisition card software;
-	2) Capture card software is used to capture and display images, and CLCtrl software is used for control.

4 Dimension and layout of the the SWIR331 series camera

4.1 The back view and dimension of the SWIR331 series camera



Figure 3 The rear cover interface layout of the SWIR331 Short-Wavelength Infrared Camera (CL interface)

4.2 Dimension of the e SWIR331 series camera

The Front and side view dimensions of the SWIR331 series camera is shown in Figure 4.



Figure 4 The Front and side view dimensions of the SWIR331 series camera

Parameter	Specification
Dimension	68*68*90.3mm
The SWIR331 series camera lens interface	Standard C mount

4.3 The back view of the SWIR331 series camera

The rear interface of the SWIR331 series camera is shown in Figure 5, the description is shown in Table 5.



Figure 5 The rear interface of the SWIR331 series camera

Table 5 The rear interface of the SWIR331 series camera

Order	Specification
1	DC 12V power slot
2	External IO connecter
3	CameraLink1
4	CameraLink2

4.4 The packing information



Figure 6 The packing information of the SWIR331 series camera

Table 6 The packing information of the SWIR331series camera

Standard Packing information				
Α	3-A equipment case: L:28cm W:23cm H:15.5cm (1pcs, 2.8Kg/ box)			
В	SWIR331 Short-Wavelength Infrared Camera			
С	2 CameraLink cables			
D	12V/3A 6 PIN air plug power adapter			
Е	Power cord. National standard, American standard, European standard, British standard power cord (D1, D2, D3, D4) for choosing			
F	One external trigger control cable			
	Optional accessary			

5 External IO connector and electrical characteristics

5.1 Pin signal

The SWIR331 series camera External IO connector is shown in Figure 7, the pin signal definitions is shown in Table 7 and Table 8.



Figure 7 The rear interface of the SWIR331 series camera

Table 7 The SWIR331 series camera DC12V pin signal definitions

	Color	Pin	Signal	Description of the signal
	Red	1	12V	
	Yellow	6	12V	12V power supply positive
(2 5)	Black	5	12V	
\\ 3	White	2	GND	
	Blue	3	GND	12V power supply negative
	Green	4	GND	

Table 8 SWIR331 series camera Trigger pin signal definitions

	2
67	3
	Ľ

	颜色	管脚	信号	信号描述说明
\mathcal{N}	Blue	3	OPTO_GND	Opto-isolated signal ground
	Green	6	OPTO_IN	Opto-isolated input signal (line0)
))	Pink	7	OPTO_OUT	Opto-isolated output signal (line1)

5.2 I/O electrical characteristics

5.2.1 Opto-isolated input circuit (line0)

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



Figure 8 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

When the input level is between 2.2V and 3.2V, the circuit operation state is uncertain, please do not let SWIR camera work within this voltage range.



Figure 9 Input logic levels

Input rise delay (TDR): 6us

Input fall delay (TDF): 6us

5.2.2 Opto-isolated output circuit (line1)

In the camera I/O control, the opto-isolated output circuit is shown in Figure 10.



Figure 10 Optocoupler output circuit

The opto-isolated output maximum current is 30mA.



Figure 11 Output logic levels

The electrical characteristics of the opto-isolated output (external voltage 5V, external resistor 1K) are shown in Table 9.

Table 9 Opto-isolated output signal's electrical characteristics

Parameter name	Parameter notation	Parameter value
Output logic low	VL	742mV
Output logic high	VH	4.134V
Output rise time	TR	4us
Output fall time	TF	1.8us
Output rise delay	TDR	12us
Output fall delay	TDF	2us

The output of the corresponding output current and VL when using different voltages and resistors in external circuit are shown in Table 10.

Table 10 Opto-isolated output logic's low levels parameters

External voltage	External resistor	VL	Output current
3.3V	1ΚΩ	510mV	2.82mA
5V	1ΚΩ	742mV	4.31mA
12V	2.4ΚΩ	795mV	4.68mA
24V	4.7ΚΩ	850mV	4.97mA

6 Connection and Configuration the CameraLink

6.1 Connection to the CameraLink

Connect the two CameraLink cables: the CameraLink1 port on the camera is connected to the CL1 port on the capture card, the CameraLink2 port on the camera is connected to the CL2 port on the capture card.

Attention: if the camera and the acquisition card cross-linking, camera will not work. Please pay special attention.

6.2 Software installation

6.2.1 Install SDK

Windows 10 system can directly select the exe shown in Figure 12 to install SDK; For Windows 7, please install the driver shown in Figure 13.

名称	修改日期	类型	大小
SaperaLTSDKSetup_8.60.exe	2023/4/28 13:49	应用程序	413,617 KB
Xtium2-CL MX4.pdf	2023/4/28 13:59	Microsoft Edge	4,426 KB
78 xtium-cl mx4 130000311.exe	2023/4/28 13:49	应用程序	43,574 KB

Figure 1	2
----------	---

😮 SaperaLTSDKSetup_8.60.exe	2023/4/28 13:49	应用程序	413,617 KB
🕅 Windows6.1-KB3033929-x64.msu	2023/8/24 10:37	Microsoft 更新独	44,843 KB
Xtium2-CL MX4.pdf	2023/4/28 13:59	Microsoft Edge	4,426 KB
78 xtium-cl_mx4_130000311.exe	2023/4/28 13:49	应用程序	43,574 KB

Figure 13

6.2.2 Install options

The following is the interface to be selected, and the rest of the steps can be directly clicked next.



Figure 14



Figure 15

6.2.3 Install the driver

The exe shown in Figure 16 is the driver of the capture card (xtium-cl_mx4) currently used by our company, and the drivers of dalsa acquisition cards are different.

Capture card driver installation steps can be all click Next.

Ttium2-CL MX4.pdf	2023/4/28 13:59	Microsoft Edge	4,426 KB
75 xtium-cl_mx4_130000311.exe	2023/4/28 13:49	应用程序	43,574 KB

Figure 16

Restart your computer after the installation is complete.

6.3 Configure the Delsa capture card

6.3.1 Serial port configuration

Find the software Sapera Configuration in Figure 17 of the DALSA supporting tool, open it, change COM port mapping (optional) to the required port (currently COM2) as shown in Figure 18, and restart the computer according to the program requirements.



Figure 17

	Index Name	Info	Tune	Additional Information	
	0 System 1 Xtium-CL_N	(n/a) (n/a) (x4_1 Seria	l number	C0156096	
	Contiguous Memory				
	Buffer Allocation (Lega	acy) 💌			
	Buffer Allocation Requ	ested (Legacy)	3	🕂 MBytes	
	Actual Space Allocate	đ	3	MBytes	
	CameraLink Serial Port C	onfiguration			
	Physical port name		Xtium-CL	_MX4_1_Serial_0	•
	COM port mapping (o	ptional)	COM2		•
	Teledyne DALSA can	nera detection	Automati	c Detection	•
	Sapera will try and text-based	to detect Teledyne I protocols.	DALSA cam	eras on this COM port using	both GenCP
			Auto Det	ect & Maximize	•
	Baud rate setting		- Auto Doc		
	Baud rate setting Sapera will find highest commo	the baud rate that n baud rate suppor	the camera i ted by the ca	s currently set to and then fi amera and the frame grabbe	nd the r.
	Baud rate setting Sapera will find highest commo Multi-threaded transfer	the baud rate that n baud rate suppor callback optimizati	the camera i ted by the ca	s currently set to and then fi imera and the frame grabbe	nd the r.
Er ca en to are	Baud rate setting Sapera will find highest commo Multi-threaded transfer abling this feature far abled for a fully tested a abled for a fully tested a usally sufficient.	the baud rate that in baud rate suppor callback optimizati nprove transfer call nn) from the same S oplication after othe been implemented i	the camera i ted by the ca on back perform apera applica n the applica	s currently set to and then fi imera and the frame grabbe hance when using multiple ation. However, it should or te improvement methods rela- tion source code, since the	nd the r. hly be ated se

Figure 18 Serial port configuration dialog box

6.3.2 CameraLink mode configured

Open the software in Figure 19 and verify that it looks like Figure 20. If not, please click the Manual button in Figure 20 to modify the tart as shown in Figure 21, and click the tart Updat button to wait for the completion of the update. If an error occurs, please confirm whether the serial port control is turned off.



Select '' Manual '' to u	update with a Specific	Configuration	
Device	Serial Number	Configuration	Status
<tium-cl_m×4_1< td=""><td>C0156096</td><td>1 x Full Camera Link</td><td>Update Not Required</td></tium-cl_m×4_1<>	C0156096	1 x Full Camera Link	Update Not Required

Figure 20

🛪 Teledyne DALSA	Device Manager v:3.79.0.0		-	\times
File Tools Help				
Firmware Update Man	ager			
tart Updat Save	Config file Load Config File	Same Configuration For All Devices		
Device	Field	Value		
Xtium-CL_MX4_1	Serial Number	C0156096		
Update Firmware 🔽	Device Version	0x000000000202001		
_	ACU/DTE + PCIe Interface	1.30.00.0311		
	Configuration	1 x Full Camera Link		-
L.	Information	Support for one Full Camera Link camera.		
Firmware State		Update Not Required		
Device Info Fi	rmware Update			
Dutput				
1				
				^

Figure 21

6.3.3 Configuring CameraLink Receiving

Opening the Sapera CamExpert software of DALSA, click the arrow position in Figure 22 and select SWIR331KMA_CL_Medium_12bit_4Ports_640x512_V1.0.ccf to load the configuration information of the receiving format of CameraLink.

രം പലം വ					
DeviseSelector		×			
Devide: 📑 Xtium-CLJ	1X4_1 🍃 CameraLink Fu	ll Mono 💌			
Configur Select a came	ra file (Optional)	-			
CameraLink Dete I	letect Camera	Settings			
Detec	tion 'Automatic' and bau	idrate ´Auto-Detect			
Parameters		×			
Category	Parameter	Value			
Basic Timing	Camera Type	Areascan			
Advanced Control	Color Type	Monochrome			
Pixel Depth 12					

Figure 22 Load the CameraLink receive format configuration information

The arrangement is shown in Figure 23(You do not need to change the arrangement of the ccf files mentioned above).

Parameter	Value
Cameralink Configuration	Medium
# of Segment per Line (TA	4
TAPS Geometry	Multiple Taps Interleaved
# of Channel	1
Interline Channel Order	Normal, Channel A - B
Tap/Channel 1 Direction	Left to Right , Top to Bott
Tap/Channel 2 Direction	Left to Right , Top to Bott
Tap/Channel 3 Direction	Left to Right , Top to Bott
Tap/Channel 4 Direction	Left to Right , Top to Bott
Tap 5 Direction	Left to Right , Top to Bott
Tap 6 Direction	Left to Right , Top to Bott
Tap 7 Direction	Left to Right , Top to Bott

Figure 23 Arrangement

6.3.4 CameraLink Receiving the configuration content

The image below shows the resolution and bit depth Settings.

	Parameter	Value			
	Camera Type	Areascan			
	Color Type	Monochrome			
1	Pixel Depth	12			
	Horizontal Activ	640			
	Horizontal Offs	0			
	Vertical Active (512			
	Vertical Offset (0			
	Pixel Clock Inp	85			
	Data Valid	Disabled			
	Camera Sensor	Custom			
	PoCL	Disabled			
	PoCL Status	Not Active			

Figure 24

The steps of Camera Sensor Geometry Setting are shown in Figure 25 and Figure 26.

Parameter	Value
Camera Type	Areascan
Color Type	Monochrome
Pixel Depth	12
Horizontal Ac	640
Horizontal Of	0
Vertical Active	512
Vertical Offse	0
Pixel Clock In	85
Data Valid	Disabled
Camera Sens	Custom
PoCL	Disabled
PoCL Status	Not Active

Figure 25





The Settings are as follows:

. ~

Parameter	Value
Cameralink Configuration	Medium
# of Segment per Line (TA	4
TAPS Geometry	Multiple Taps Interleaved
# of Channel	1
Interline Channel Order	Normal, Channel A - B
Tap/Channel 1 Direction	Left to Right , Top to Bott
Tap/Channel 2 Direction	Left to Right , Top to Bott
Tap/Channel 3 Direction	Left to Right , Top to Bott
Tap/Channel 4 Direction	Left to Right , Top to Bott
Tap 5 Direction	Left to Right , Top to Bott
Tap 6 Direction	Left to Right , Top to Bott
Tap 7 Direction	Left to Right , Top to Bott

Figure 27

6.4 Using Genlcam

6.4.1 Communication Settings

Enter the interface shown in Figure 28 and set the content as shown in Figure 29.

鑬 CamExpert (version 8.60.00.2120) - [Untitled]	
File View Pre-Processing Tools Help	
Device Selector	×
Device: 🔊 Xtium-CL_MX4_1 🔊 CameraLink Full Mono 🔻]
Configur Select a camera file (Optional)	
CameraLink Dete Detect Camera Settings	
Detection 'Automatic' and baudrate 'Auto-Detect and Maximize'	

Figure 28

Communicati	on Settings	×			
Selected Ser	ial Port: Xtium-CL_MX4_1_Serial_0				
Protocol Det	ection				
Туре:	Automatic Detection				
CamExpert tries to detect Teledyne DALSA cameras on this COM port using both GenCP and text-based protocols.					
		_			
Serial Port Se	ettings				
Baud Rate:	Auto Detect & Maximize				
	Will find the baud rate that the camera is currently set to and then will try to find the highest baud rate supported by the camera and the frame grabber.				
Save	Settings Cancel]			

Figure 29

After the Settings are complete, properly connect the camera and restart CamExpert. Figure 30 will appear on the software interface.



Figure 30

6.5 Description of Genlcam

6.5.1 Device Information and control

As shown in Figure 31, it contains the basic information of the equipment, including exposure time control, gain control, frame rate control and TEC temperature display.

Ca	tegory	Parameter	Value
⊡	Board	Manufacturer	touptek hangzh
	Basic Timing Advanced Control External Trigger Image Buffer and ROI	Device Family	toupswir
		Model Name	toupswir331k
		Serial Number	
		expo time	100
_		gain	Middle Gain
Ξ	Attached Camera	Frame Frequence	700
	Device Information and	Deniose mode	Enable
	Image Format Controls	Deniose level	5
	TEC ctrl	TEC_temp	0.4
Trigger ctrl	Trigger ctrl		Show More >>

Figure 31

6.5.2 Image Format Controls

Figure 32 shows the ROI control.

Par	rameters		×
Category		Parameter	Value
⊡	Board	Horizontal Offset	0
	Basic Timing Advanced Control	Vertical Offset	0
		Width	640
		Height	512
	External Ingger		Show More >>
	Image Buffer and ROI		
⊡	Attached Camera - CameraLink_1		
	Device Information and control		
	Image Format Controls		
	TEC ctrl		
	Trigger ctrl		
	D '	22	

Figure 32

6.5.3 TEC Ctrl

As shown in Figure 33, TEC Ctrl contains TEC temperature control, TEC switch, fan switch, and TEC temperature display in degrees Celsius.



6.5.4 Trigger ctrl

The trigger control content Settings are shown in Figure 34 and contain the basic trigger Settings.

Par	ameters			×
Ca	tegory	Parameter	Value	^
⊡	Board	Tri mode	Disable	
	Basic Timing	Softalways	Disable	
	Advanced Control	TriSource	Opt_in	
		TriActivation	rising edge	
	External Irigger	Burst Counter	0	
Contract of	Image Buffer and ROI	CounterSource	Opt_in	
	Attached Camera	Counter Value	0	
	Device Information and Image Format Controls	PWMSource	Opt_in	
		Soft trigger	Disable	
	TEC ctrl	Tirgger Delay0	0	
	Trigger ctrl	Tirgger Delays	0	
	nigger en	Output Mode0	0	
		DurationTime	0	
		PreDelay	0	
		OutputDelay	0	
		UserValue	Opt_in	
		TriProhibited	4100	
		Counter Reset	Disable	
		Debounce0	0	
		Line Inverter	-Invalid value-	
		OutputCounter	1	~

Figure 34

7 Camera Commands

7.1 Basic Formats

The serial port of the camera CameraLink is used as the communication port. The baud rate of the serial port is 115200, and the serial port has 8 bits without check bit mode.

The protocol format is compatible with GENICAM gencp 1.0. For details, refer to GENICAM protocol.

The protocol instruction is realized by register access, each function is distinguished and defined by different register addresses, and the protocol data is divided into general part and special part. The protocol data is preceded by the general part and followed by the special part. The general part is fixed to the length of 16 bytes, and the length of the special part is variable according to the different length of the function.

The general 16-byte format is described as follows (all fields in the general part are in Big-Endian format with high bytes before them) :

Suppose the sixteen bytes of data are D0, D1, D2, D3, D4, D5, D6, D7, D8, D9, D10, D11, D12, D13, D14, D15. For command execution, the protocol stipulates that the host computer is the active initiator and the device is the passive responder.

- 1. D0, D1 is two prefix bytes, fixed as 0x01 and 0x00.
- 2. D2 and D3 are the check words of the universal partial data. The check part ranges from D6, D7 to D14, and D15 adopts double-byte CRC redundancy check, with the high byte coming first (Big-Endian).
- 3. D4 and D5 are the check words for the total protocol data. The check part runs from D6 and D7 to the end of the entire protocol data. Double-byte CRC redundancy check is also adopted, with the high byte in the front (Big-Endian).
- 4. D6 and D7 are channel ids. At present, the device channel is fixed to 0, and the data is 0x00 and 0x00.
- 5. D8 and D9 are common flag fields. For the upper computer, if the value is 0x40, 0x01 indicates that the normal function request is sent and the device needs to respond. If the value is 0x00, 0x01 indicates that the normal function request is sent and the device does not need to respond. For the response of the device, the field is 0x00. 0x00 indicates that the device receives the response correctly and there is no exception.
- 6. D10 and D11 are command ids, which are general command definition fields. For the upper computer, the values are 0x08 and 0x00 when reading data and 0x08 and 0x02 when writing data. For the device, the value is 0x08, 0x01 when it responds to read data, 0x08, 0x03 when it responds to write data.
- 7. D12, D13 indicates the length of the dedicated part data.
- 8. D14 and D15 are sequence ids. For the upper computer, the sequence ID needs to be increased by one for each command sent. The sequence ID remains the same for a device-side response to ensure that the host machine receives confirmation that the device-side instruction is executed correctly.

7.2 Dedicated Part Format

For the special part of the format is mainly divided into two read and write registers (register and length field is fixed in the Big-Endian format before the high byte, the rest of the data can be Big-Endian or Little-Endian, according to the custom)

1. Format description of the special part when the upper computer reads the register data

The whole dedicated data length is 12 bytes, if the data is R0, R1, R2, R3, R4, R5, R6, R7, X0, X1, X2, X3, where R0~R7 is the register address that needs to be read; X0, X1 is fixed to 0x00, 0x00; X2, X3 are the length of the data to be read (the length is the legal length defined by the register, and the length of each register is specified).

2. Format description of the special part when the device responds to the upper computer reading register data

The whole private data is the data that needs to be read, there are no other fields; The length varies according to the length of the data read, such as X1, X2, X3..... Xn; The length of the read data is n.

3. Format description of the special part of the upper computer when writing register data

When the upper computer writes register data, the special part of the data consists of two parts: register and data, such as R0, R1, R2, R3, R4, R5, R6, R7, X1, X2, X3..... Xn; R0 to R7 indicates the register address (REG_ADDR). X1 to Xn indicates the data to be written. The length of the data to be written is n, which is the legal length specified by the register.

4. Format description of the special part when the device responds to the host computer to write register data

When the device successfully writes data from the host computer, the dedicated data part of the device response is fixed as 0x00, 0x00, 0x00, 0x00.

7.3 Definition of each register

ADDR_BASE =0x000000020000000

REG_ADDR= ADDR_BASE + ADDR_OFFSET

Number	Register function	Register address (ADDR_OFFSET)	Register value	default parameters	data length	R/W	Data sequence
1	ROI columns	0x070	32 to 640- Column start position	0	4byte	RW	little
2	ROI column starting position	0x080	0~608	640	4byte	RW	little
3	ROI rows	0x090	4 to 512- The starting position of the line	0	4byte	RW	little
4	ROI row starting position	0x0A0	0~508	512	4byte	RW	little
5	Exposure	0x200	16~100000(us)	100	4byte	RW	Big
6	Gain	0x210	0/1/2(Hg/Mg/Lg)	1	4byte	RW	Big
7	Frame rate control	0x230	1~700	700	4byte	RW	Big
8	Denoising level	0x280	1~10	5	4byte	RW	Big
9	Algorithm control	0x2b0	Obit: Delect defective pixel switch 1bit: Dark field correction switch 2bit: Denoise switch	7	4byte	RW	Big
10	Defective pixel reload	0x320			4byte	W	Big
11	TEC Temperature Setting	0x330	T(℃)=data/10, complement-on-two	0	4byte	RW	Big
12	TEC temperature reading	0x340	T(℃)=data/10, complement-on-two		4byte	R	Big
13	TEC switch control	0x350	1 is on and 0 is off	1	4byte	RW	Big
14	Fan control	0x360	1 is on and 0 is off	1	4byte	RW	Big
15	Automatic dark field switch	0x370	1 is on and 0 is off	1	4byte	RW	Big
16	Manual dark field selection	0x380	1~15	1	4byte	RW	Big
17	Auto exposure switch	0x390	1 is on and 0 is off(Not supported yet)	0	4byte	RW	Big
18	tri_mode	0x400	0-Normal Mode 1-Trigger Mode	0	4byte	RW	Big
19	soft_always_en	0x410	0-soft disable 1-soft always enable	0	4byte	RW	Big
20	tri_source_i	0x420	trigger source: 0-Opt_in	0	4byte	RW	Big

			1-GPIO_0				
			2-GPIO_1				
			3-counter				
			4-PWM				
			5-software				
			0-rising edge;				
			1-falling edge;	-			
21	tri_activation_i	0x430	2-level high:	0	4byte	RW	Big
			3-level low				
22	burst_counter_i	0x440	0-65535	0	4byte	RW	Big
22	countor courco i	0×450		0	Abuto	D\A/	Pig
23	counter_source_i	0x450		0	4byte	RVV	ыв
			2-GPI0_0				
24	counter_value_i	0x460	Frequency division	0	4byte	RW	Big
			coefficient		-		_
			0-Opt_in	-			
25	pwm_source_i	0x470	1-GPIO_0	0	4byte	RW	Big
			2-GPIO_1				
			Obit: GPIO_0: 0-input,1-				
26	IO link	0x480	output	0	4byte	RW	Big
20	10_mm	0, 100	1bit: GPIO_1: 0-input,1-	Ũ	ibyte		516
			output				
27	soft_start	0x490	software trigger	0	4byte	W	Big
			when the Opt_in tirgger				
20	tui dalau O i	0::1=0	assert, the start of exposure	0	4	D) 4/	Die
28	tri_delay_0_l	0x4a0	will delay	0	4byte	RW	BIg
			0-32xffff ffff(cycle)				
			when the GPIO 0 tirgger				
			assert, the start of exposure	_			
29	tri_delay_1_i	0x4b0	will delay 0-	0	4byte	RW	Big
			32xffff ffff(cvcle)				
			when the GPIO 1 tirgger				
			assert the start of exposure				
30	tri_delay_2_i	0x4c0	will delay	0	4byte	RW	Big
			0_{-32} xffff ffff(cycle)				
			when the software tirgger				
			assert the start of exposure				
31	tri_delay_s_i	0x4d0	will dolay	0	4byte	RW	Big
							-
			Ont out output model 0				
			Controller Mait				
22		0::1=0	1 Fund a surge A active	0	4	D) 4/	Die
32	output_mode_0_i	0x4e0	1-Exposure Active	0	4byte	RW	BIg
			2-Strobe				
			3-User output				
			GPIO_0 Output mode: 0-				
			Frame Trigger Wait	_			
33	output_mode_1_i	0x4f0	1-Exposure Active	0	4byte	RW	Big
			2-Strobe				
			3-User output			ļ	
			GPIO_1 output mode: 0-				
			Frame Trigger Wait				
34	output_mode_2_i	0x500	1-Exposure Active	0	4byte	RW	Big
			2-Strobe				
			3-User output				
			Strobe duration				
35	duration_time_i	0x510	time:effective time 0-	0	4byte	RW	Big
			32xffff_ffff(cycle)				
26	nun dalau i	0	advance the exposure time	0	4 hunter	DIA	Die
36	pre_delay_l	UX520	0-32xffff_ffff(cycle)	U	4byte	ĸw	ыд
		0 500	later than exposure time 0-	-			<u> </u>
37	output_delay_i	0x530	32xffff ffff(cvcle)	0	4byte	RW	Big
38	user value	0x540	Opt_outuser value	0	4byte	RW	Big
		0.5-5	next trigger rising prohibited				
39	tri_pronibited_i	UX550	time 4100~32xffff_ffff(cycle)	4100	4byte	КW	ыд

40	counter_reset	0x560	When counter_reset assert, the counter of trigger will be reseted	0	4byte	w	Big
41	debounce_0	0x570	debounce time: 0-20000us	000us 0		RW	Big
42	debounce_1	0x580	debounce time: 0-20000us	0	4byte	RW	Big
43	debounce_2	0x590	debounce time: 0-20000us	0	4byte	RW	Big
44	line_inverter	0x5a0	1-enable	3'b111	4byte	RW	Big
45	output_counter_i	0x5b0		1	4byte	RW	Big
46	pause	0x5c0		0	4byte	RW	Big
47	Frame count cleared to zero	0x5d0	Obit: frame_clr 1bit: tri_clr 2bit: time_clr 3bit: all_clr	0	4byte	W	Big
48	Frame count display switch	0x5e0		0	4byte	RW	Big
49	Dark field threshold control	0x5f0	0-16384	16383	4byte	W	Big
50	Version	0x3a0	MCU Version + maximum frame rate + Firmware version + Firmware date		16byte	R	Big
51	Read mode switching	0x1f0	0: IWR(Integrate while reading) 1: ITR(Integrate then read)	1	4byte	RW	Big

8 SDK & CLView application

8.1 SDK

The camera control supports two modes: 1) Controlled through private SDK development kit; 2) Controlled by GenlCam interface.

8.2 CLView application



Figure 35 Software interface

CLView software can achieve complete control of the camera, and open source to customers to use, while providing technical support.

Description of the main functions of CLView software:

Serial port control;

Exposure time control;

Gain mode control;

ROI control;

Frame rate control;

Trigger mode control;

Dark field correction control;

TEC and Fan control;

Refrigeration temperature control;

Real-time frame rate display;

Real-time temperature monitoring;

Save picture;

Video;

Update online;

Accept customer OEM functions customized.

8.3 CLCtrl software

The camera can capture and display images through the software CameraLink capture card, and use the CLCtrl software to control. Start the CLCtrl software first, and then start the acquisition card software after obtaining the control of the serial port.

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		_		~					
Acquisition									
COM:	COM2			\sim					
	Start								
'									
Exposure				-					
Auto Exposur	e								
Exposure Time:				0us					
Conversion Gain:									
Hg	Mg			Lg					
- <u>6</u>									
Trigger									
Trigger									
Trigger Source:	Opto-isol	ated		\sim					
	C . D								
	Software In	ngger							
ROI				•					
Frame Rate 🗸 👻									
Temperature 🗸 🗸									
Denoise 🗸 🗸									
Sharpen 🔻									
Dark Field Correction 🔹 🔻									
Flat Field Correction 🔹 🔻									
Flip 🔺									
Horizontal									
Vertical									
Update Firmwa	ire			T					
Diagnose 🗸 🗸									