TWIN612

Product Specification V1.2

(Observation type & Thermography type)

User Instructions

Precautions for safe use

This content is to ensure that the user uses the product properly to avoid danger or property damage. Before using this product, please read the instructions carefully and properly keep it for future reference.

As shown below, the precautions are divided into two parts, i.e., "warnings" and "cautions":

Warning: Ignoring a warning may result in death or serious injury.

Caution: Ignoring a caution may result in injury or property damage.

Warning Instructions to ensure the users to avoid potential dangers may result in death or serious injury.	**Caution** Instructions to ensure the users to avoid potential dangers may result in injury or property damage.

Warnings

- Install and use this product in strict accordance with all relevant national and local electrical safety regulations.
- Use power adapters supplied by legitimate manufacturers, power supply of the module: DC5V/2A.
- Do not connect multiple modules to a power adapter (overload of the adapter may result in excessive heat or fire).
- Power off the module during wiring, disassembly and other operations, do not allow live operation.
- Immediately power off the module off in the event of smoke, stench or noise during its use, and contact the distributor or service center to deal with related matters.
- If the equipment does not work properly, please contact the store where you purchased the equipment or the nearest service center. Do not disassemble or modify the equipment in any way. (We are not liable for any problems arising from unauthorized modification or repair).

Cautions

- Do not drop any object on the equipment or vigorously shake the equipment, and keep the equipment away from magnetic field interference. Avoid installing the equipment to a place where the surface vibrates or is subject to impact. (Ignoring this may damage the equipment).
- Do not use the equipment in environment with high temperature (higher than 70℃) or low temperature (lower than -40℃) or high humidity (higher than 95%).
- Do not expose the module to objects giving out bright light, such as sun, otherwise the module will be damaged.
- Do not place the equipment in a location under direct sunlight or a poorly ventilated location, or near heat source such as heater or heating (ignoring this may cause a fire hazard).
- Do not frequently power on/off the machine, turn it on at least 30 seconds after it is turned off, otherwise the module life will be affected.
- Do not hot swap the 50pin interface, which will cause damage to the module.
- Do not touch the surface coating of the module lens directly with your hand, or scratch the lens with a hard object, which may lead to blurred imaging, affecting image quality.
- Use sufficiently soft dry cloth or other alternatives to wipe the lens surface to clean the module. Do not use alkaline detergent.

Disclaimer

Please ensure that you have read and fully understand the product instructions and the statement before using this product. You should install and use this product in strict accordance with the product instructions. If the user fails to strictly follow the instructions to install and use this product, it may bring great inconvenience to use, and may even cause property damage and personal injury. We assume no legal responsibility for any property damage and personal injury arising from improper installation or improper use of the product.

Service Principle

The series of products enjoy one-month replacement and one-year warranty. The specific service principle shall follow the provisions on the attached warranty card to perform warranty services. For products that have been discontinued, obsolescence or sold at a discount, the execution time shall follow written documents such as the notice of company.

Document Version

Date	Version	changes	author
2022/04	V1.0	/	WEN
2022/06	V1.1	Remove the TBD tags for BT.656 related content	Ding
2022/08	V1.2	Add the lens information of module，page7~page9，page84~page85.	Ding

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1 Product Overview

1.1 Product description

TWIN series core is a high-resolution general-purpose uncooled infrared thermal module, characterized with large area array, high resolution, impact and vibration resistant and good scalability.

TWIN612 is based on the ceramic detector of Global Sensor Technology and has the following features:

- Small size, the whole size is not more than 25.4mm*25.4mm*35mm(without lens)
- The weight is as light as 25.8g
- Fast imaging and less than 6s start-up time
- Power consumption is as low as 0.9W
- Support non-uniformity correction (NUC)
- 3D image noise reduction (3DNR)
- 2D Digital noise reduction（DNS）
- Wide Dynamic Range Compression (DRC)
- EE enhancement
- Strong extension ability, support VPC/USB and other extension components, plug and play, easy to integrate

At the same time, the series movement is equipped with high-performance signal processing circuit and image processing algorithm, which ensures the definition and smoothness of image quality. As a basic thermal imaging module, it provides various industry standard interfaces, which will facilitate secondary development for OEM customers. It offers standard professional thermal imaging solutions for many applications, such as power monitoring, industrial maintenance, security and outdoor sports.

The basic framework of the TWIN module is shown in Figure 1-1.

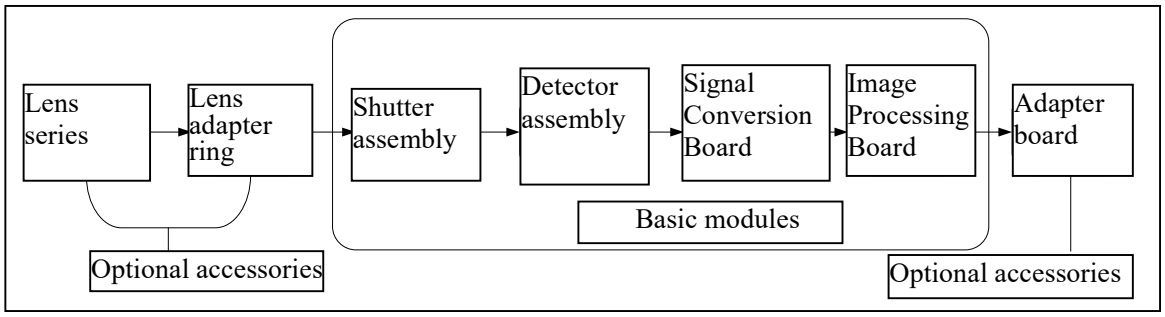


Figure 1-1 Basic framework of TWIN module

The basic core module is the basic unit of the core, which mainly completes the basic imaging functions of the infrared thermal module, including the shutter assembly, the detector assembly, the image processing assembly and the power supply unit. The shutter assembly uses an electromagnetic valve shutter, which has the advantages of good uniformity and short response time. The detector assembly includes infrared detector, PCB and inter-board connector. The signal conversion board is used to realize basic signal processing circuits and time-series transmission channels. The image processing board is mainly used to complete the image processing, analog video and digital video output, as well as power supply of the whole system.

1.2 Product configuration

1.2.1 Technical specification — TWIN612(Observation type)

Detector: uncooled vanadium oxide, 640x512

- Pixel pitch: 12um
- Spectral: 8~14um
- NETD: ≤ 40mk@F1.0@25℃

Output: supports analog video and digital video

Output frame frequency: 25hz / 30hz configurable, default 25hz

Analog video: CVBS, 75Ω characteristic impedance

Support PAL system and NTSC system, switchable

Digital video:

Support 8bit/16bit parallel CMOS, default 8bit；

Support USB2.0 digital video；

Support BT.656(8bit, progressive) ；

Control communication: RS232-TTL/USB(Select-able)

- Boot time: ≤6S, Boot screen supports customization

Physical properties

- lens:13mm/25mm/35mm/50mm/70mm
- Dimension: 25.4mm*25.4mm*35.0mm(without lens)
- Assembly interface

13mm/25mm lens：M1.6x 3.5, 2pc / side, 3 sides in total

35mm lens：M2x 3.5, 2pc / side, 3 sides in total

50mm/70mm lens：（1）mounting hole：M2x 3.5, 4pc / side, 1 sides in total

（2）locating hole： Φ1.5,4pc / side, 1 sides in total

Electrical properties

- Power supply: DC 4-5.5V, typical power consumption ≤ 0.9W @ 5V @23 ± 3℃
- Expansion board: USB2.0 board/USB3.0 board/VPC board,plug and play

Environmental properties

- Working temperature: -40℃ to +70℃

- Storage temperature: -45℃ to +85℃
- Humidity: No condensation at 5% - 95% RH
- Impact and vibration resistance:

  Vibration: 5.35grms,3 axis
  Impact: half sine wave,40g/11ms,3-axis,6-direction
- ROHS Certification

1.2.2 Technical specification — TWIN612R(Thermography type)

Detector: uncooled vanadium oxide, 640x512

- Pixel pitch: 12um
- Spectral: 8~14um
- NETD: ≤ 40mk@F1.0@25℃

Output: supports analog video and digital video

Output frame frequency: 25hz / 30hz configurable, default 30hz

Analog video: CVBS, 75Ω characteristic impedance

Support PAL system and NTSC system, switchable

Digital video:

Support 8bit/16bit parallel CMOS, default 8bit；

Support usb2.0 digital video；

Support BT.656(8bit, progressive)；

Control communication: RS232-TTL/USB(option)

- Boot time: ≤6S, Boot screen supports customization
- Support image enhancement and pseudo-color
- Support SDK for secondary development and function extension

Physical properties

- lens: 13mm
- Dimension: 25.4mm*25.4mm*35mm (without lens)
- Assembly interface: M1.6x3.5, 2pc / side, 3 sides in total

Electrical properties

- Power supply: DC 4-5.5V, typical power consumption ≤ 0.9W @ 5V @23 ± 3℃
- Expansion board: USB2.0 board，plug and play

Environmental properties

- Working temperature: -40℃ to +70℃
- Storage temperature: -45℃ to +85℃
- Humidity :No condensation at 5% - 95% RH
- Impact and vibration resistance:

  Vibration: 5.35grms,3 axis
  Impact: half sine wave,40g/11ms,3-axis,6-direction
- ROHS2.0/REACH

Thermography:

- Temperature measuring range: -10℃ ~ +50℃.
- Temperature accuracy：±2℃或±2%(maximum value)@23℃±3℃，Temperature measuring distance: 5m.
- Temperature range：-20℃~+150℃, 0~550℃， specific requirements can be customized.
- Area temperature measurement: supports any area temperature measurement, output area maximum, minimum and average value.
- Point temperature measurement: supports any point temperature measurement.
- Provide Windows/Linux version SDK to realize video stream analysis and grayscale to temperature conversion.
- Support pseudo color (≥11 kinds), specific requirements can be customized.

1.2.3 Optical configuration

The optical configuration of the TWIN module is shown in Table 1-1.

Table 1-1 Optical configuration

Focal length	Coating	Resolution	f/#	FOV (H×V, ±5%)	Size (Module+Lens)	Weight (Module+Lens)
13mm(Athermal)	DLC	640×512@ 12um	1.0	32.9°x26.6°	25.4mm*25.4mm*48mm	48g
25mm(Athermal)	DLC	640×512@ 12um	1.0	17.46°x14°	Φ35.4mm*52.75mm	75.5g
35mm(Athermal)	DLC	640×512@ 12um	1.0	12.52°x10°	Φ48.4mm*64.3mm	131g
50mm(Athermal)	DLC	640×512@ 12um	1.0	8.78°x7.03°	Φ62mm*77.1mm	188g
70mm(Athermal)	DLC	640×512@ 12um	1.0	6.28°x5.03°	Φ84mm*104.5mm	440g

Note:
Lenses series of TWIN612 support front lens IP67,DLC stand for Hard-carbon film.

1.3 Description of PC control software

Infrared Camera Controller enables online control of the TWIN series.

The PC control software can be used in windows 7/8/10/XP and other operating systems.

Support Chinese/English language.

The typical baud rate is 115200.

1.4 Unpacking

The standard configuration chassis contains a module, a product certificate and accessories.

The module shall be unpacked and used in environment with good electrostatic protection as it contains electrostatic sensitive electronic components. The module shall be put in an antistatic bag to avoid electrostatic damage.

The packing box shall be filled with foam material to prevent damage to the module during transport.

2 Electrical interface instructions

2.1 Input power requirements

The steady-state power consumption of TWIN612 module ≤ 0.9W@5V, 23±3℃

When compensating the shutter, the transient power consumption ≤ 2W@1s;

Insufficient power supply may cause abnormality in start-up and operation.

When using expansion board, the power supply voltage range of the module is: DC:4V-5.5V. This voltage refers to the voltage supplied to the circuit board. In practical application, please consider the influence of line loss and reserve sufficient margin.

2.2 Hardware Interface

The external interface of bare TWIN module is 50PIN interface which includes functions of power input/ output, digital/analog video output, RS232-TTL serial port and independent IO etc.

The external interface model of module is:DF40C-50DP-0.4V (51), (HRS, male connector). The recommended external interface model is：DF40HC (3.5)-50DS-0.4V (51), (HRS, female connector).

The position of HRS 50-PIN interface on the circuit board and the pin sequence are shown in Fig. 2-1, XS1. The dimension unit in Fig. 2-1 is mm; relative to the upper left positioning hole center, the coordinate of the first pin center for 50Pin base is (6.41, 1.62).

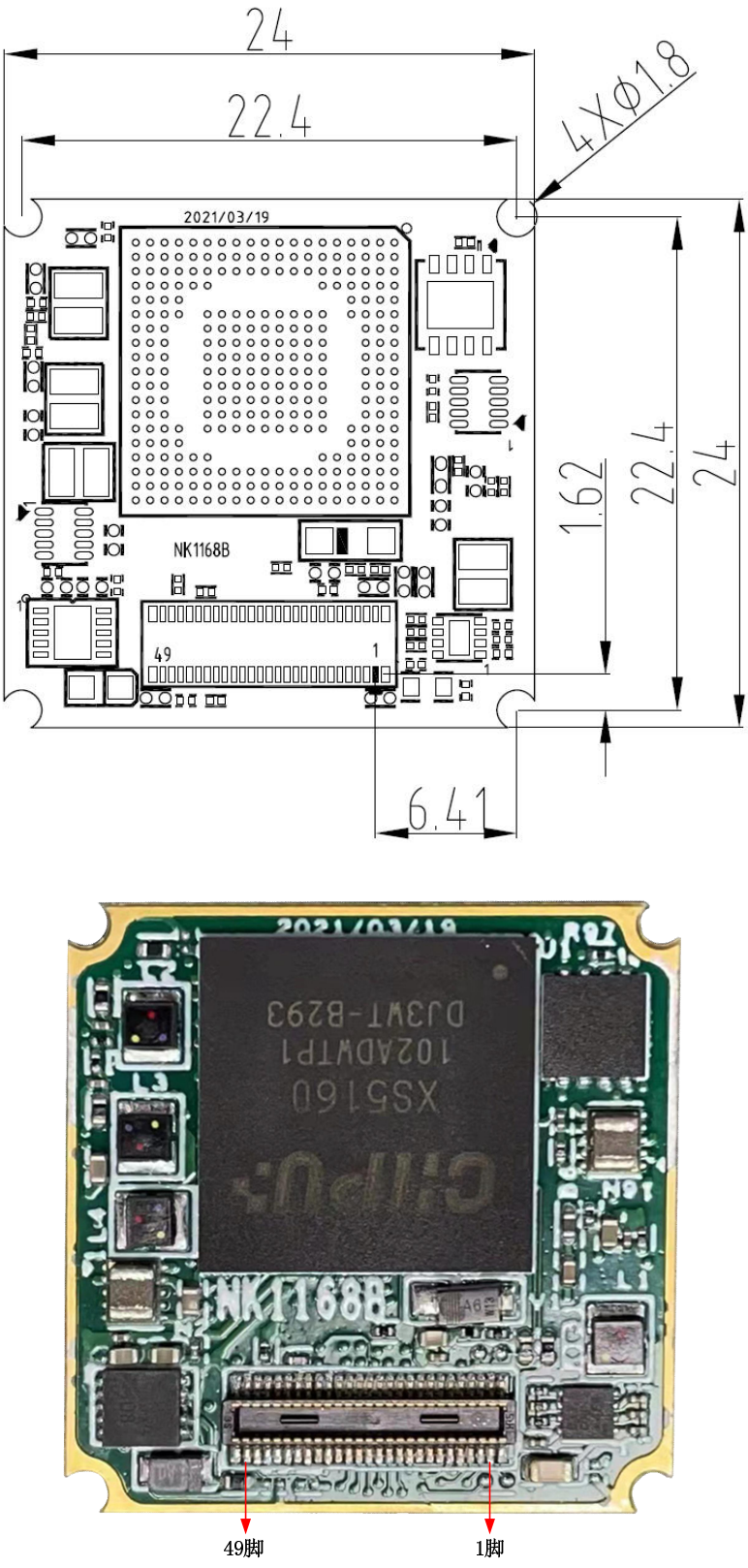


Fig. 2-1 The coordinate diagram and the entity of HRS 50-PIN interface

The definition of HRS 50-PIN external interface is shown in Table 2-1.

Table 2-1 The definition of 50-PIN interface

S/N	Signal definition	Signal direction	Level	Description
1	UART0_TXD/ USB_DM	O/IO	H 3.3V/L 0V	Send UART0 (core port, the same below)/ USB2.0_DM

2	UART0_RXD/ USB_DP	I/IO	H 3.3V/L 0V	Receive UART0/ USB2.0_DP
3	Reserved	O	/	NC
4	Reserved	O	/	NC
5	I2C_SCL	IO	H 1.8V/L 0V	Clk of I2C BUS
6	I2C_SDA	IO	H 1.8V/L 0V	Sda of I2C BUS
7	DGND	GND	0V	Power ground
8	DGND	GND	0V	Power ground
9	DATA_VALID	O	H 1.8V/L 0V	
10	DGND	GND	0V	NC
11	LVDS_CLK_P	O	H 1.8V/L 0V	NC
12	LVDS_CLK_N	O	H 1.8V/L 0V	NC
13	LVDS_DATA0_P	O	H 1.8V/L 0V	NC
14	LVDS_DATA0_N	O	H 1.8V/L 0V	NC
15	LVDS_DATA1_P	O	H 1.8V/L 0V	NC
16	LVDS_DATA1_N	O	H 1.8V/L 0V	NC
17	DGND	GND	0V	Power ground
18	DGND	GND	0V	Power ground
19	DIGITAL_HS	O	H 1.8V/L 0V	Digital video signal
20	DIGITAL_VS	O	H 1.8V/L 0V	Digital video signal
21	DATA_OUT15	O	H 1.8V/L 0V	Digital video signal
22	DATA_OUT14	O	H 1.8V/L 0V	Digital video signal
23	DATA_OUT13	O	H 1.8V/L 0V	Digital video signal
24	DATA_OUT12	O	H 1.8V/L 0V	Digital video signal
25	DATA_OUT11	O	H 1.8V/L 0V	Digital video signal
26	DATA_OUT10	O	H 1.8V/L 0V	Digital video signal
27	DATA_OUT9	O	H 1.8V/L 0V	Digital video signal
28	DATA_OUT8	O	H 1.8V/L 0V	Digital video signal
29	DATA_OUT7	O	H 1.8V/L 0V	Digital video signal
30	DATA_OUT6	O	H 1.8V/L 0V	Digital video signal
31	DATA_OUT5	O	H 1.8V/L 0V	Digital video signal
32	DATA_OUT4	O	H 1.8V/L 0V	Digital video signal
33	DATA_OUT3	O	H 1.8V/L 0V	Digital video signal
34	DATA_OUT2	O	H 1.8V/L 0V	Digital video signal
35	DATA_OUT1	O	H 1.8V/L 0V	Digital video signal
36	DATA_OUT0	O	H 1.8V/L 0V	Digital video signal
37	DGND	GND	0V	Power ground
38	DGND	GND	0V	Power ground
39	DATA_OUT_CLK	O	0V	Clock signal
40	EXT_SYNC	I/O	0V	External synchronizing signal
41	DGND	GND	0V	Power ground
42	DGND	GND	0V	Power ground
43	VIDEO_OUT	O	0-1V	Analog video signal output
44	VIDEO_AGND	GND	0V	Analog video ground
45	DGND	GND	0V	Power ground
46	POWER_IN	POWER-IN	4-5.5V	Power input
47	DGND	GND	0V	Power ground
48	POWER_IN	POWER-IN	4-5.5V	Power input
49	DGND	GND	0V	Power ground
50	1.8V	O	1.8V	1.8V Power Output

Note: The signal direction “O” stands for the output, “I” stands for the input and “NC” stands for suspend.

The digital signal Y8/Y16/ BT.656 hardware physical interface is compatible, and the digital signal output type can be switched by ICC control software.

When customers use external synchronous signal, the pin must connect 10 kΩ resistance and drop down to GND.

The multiplex digital signal hardware interface is shown in Table 2-2

Table 2-2 The definition of digital port

Signal definition	Interface S/N	Output type of digital port		
		Parallel port 8bit	Parallel port 16bit	BT.656
DATA_OUT_CLK	39	Y8_CLK	Y16_CLK	BT656_CLK
EXT_SYNC	40	EXT_SYNC	EXT_SYNC	/
DATA_OUT0	36	Y8_D0	Y16_D0	BT656_D0
DATA_OUT1	35	Y8_D1	Y16_D1	BT656_D1
DATA_OUT2	34	Y8_D2	Y16_D2	BT656_D2
DATA_OUT3	33	Y8_D3	Y16_D3	BT656_D3
DATA_OUT4	32	Y8_D4	Y16_D4	BT656_D4
DATA_OUT5	31	Y8_D5	Y16_D5	BT656_D5
DATA_OUT6	30	Y8_D6	Y16_D6	BT656_D6
DATA_OUT7	29	Y8_D7	Y16_D7	BT656_D7
DATA_OUT8	28	/	Y16_D8	/
DATA_OUT9	27	/	Y16_D9	/
DATA_OUT10	26	/	Y16_D10	/
DATA_OUT11	25	/	Y16_D11	/
DATA_OUT12	24	/	Y16_D12	/
DATA_OUT13	23	/	Y16_D13	/
DATA_OUT14	22	/	Y16_D14	/
DATA_OUT15	21	/	Y16_D15	/
DIGITAL_VS	20	Y8_FIELD_VALID	Y16_FIELD_VALID	/
DIGITAL_HS	19	Y8_LINE_VALID	Y16_LINE_VALID	/

Notes:

Y16 data are parallel 16bit data, Y16_D0 stands for low order, and Y16_D15 stands for high order.

Y8 data are parallel 8bit data, Y8_D0 stands for low order, and Y8_D7 stands for high order.

YUV format , 16bit parallel data: D15~D8 is Y signal, D7~D0 is UV data;

EXT_SYNC: Only for external synchronization requirements, not necessary digital port signal, support external synchronization input and external synchronization output mode, when do not use the external synchronization interface, be sure to turn off the external synchronization function.

2.3 Details of digital video

Data format: output by cb, y, cr, y or y, cb, y, cr；

Support line by line mode, do not support separate line mode;

You can configure the clock according on the resolution size, or customize the blanking rows and head numbers；

Resolution

Yuv or raw: The maximum support resolution is 640 x 515， the effective resolution is 640 x 515, there are 3 rows of parameter line data, and the rest of the data is avoiding synchronous code data 0xfe.The resolution can be assigned to 640 x 512 or 640 x 515 in applications.

Yuv + raw: The maximum support resolution is 1280 x 516, where the effective resolution is 1280 x 512, with another 3 lines of parameter line data and avoidance synchronization code data. It can be configured as 1280 x 512 or 1280 x 515 applications.

Only transmission by frame is supported, and two transfers are not supported for the same frame data.

The movement supports a variety of digital video formats for output. The output video clock is related to the standard, frame frequency and cmos interface bit width, as shown in Table 2-3.

Table 2-3 Overview of digital video clock（Unit：MHz）

Data source	resulotion	640*512	
	Frame rate	25Hz/30Hz	
	Bit width	16bit	8bit
Y16		10.875	21.75
Y16+para.		10.875	21.75
YUV422		10.875	21.75
YUV422+para.		10.875	21.75
YUV422+Y16		21.75	43.5
YUV422+Y16+ para.		21.75	43.5
BT656（TBD）		/	21.75
NOTE		1. BT656 25 valid resolution is 640*512.	

The data format is as follows:

Y16

- CMOS16：Y16[15:0], Y16[15:0], etc
- CMOS8(MSB)：Y16[15:8],Y16[7:0], Y16[15:8],Y16[7:0],etc
- CMOS8(LSB)：Y16[7:0],Y16[15:8], Y16[7:0],Y16[15:8],etc

YUV422

- CMOS16：YCb[15:0],YCr[15:0], YCb[15:0],YCr[15:0],etc
- CMOS8(MSB)：Y[7:0],Cb[7:0],Y[7:0],Cr[7:0],Y[7:0],Cb[7:0],Y[7:0],Cr [7:0],etc
- CMOS8(LSB)：Cb[7:0],Y[7:0], Cr[7:0],Y[7:0], Cb[7:0],Y[7:0], Cr[7:0],Y[7:0], etc

Note：

1.CMOSx use x physical channel for data transmission;

2.Patameter line format：

- CMOS16：Head1[15:0], Head2[15:0],Para1[15:0]，Para2[15:0]…Para40[15:0]，End1[15:0]，End2[15:0]；
- CMOS8(MSB)：Head1[15:8] ,Head1 [7:0], Head2[15:8] ,Head2 [7:0],Para1[15:8] ,Para1[7:0] ,Para2[15:8] ,Para2[7:0] …Para40[15:8] ,Para40[7:0] End1[15:8],End1[7:0] ,End2[15:8],End2[7:0] ;
- CMOS8(LSB)：Head1[7:0], Head1 [15:8], Head2[7:0], Head2 [15:8], Para1[7:0], Para1[15:8] , Para2[7:0] ,Para2[15:8] …Para40[7:0] ,Para40[15:8] End1[7:0],End1[15:8] ,End2[7:0],End2[15:8] ;

2.3.1 8bits parallel data（CMOS8）

2.3.1.1 CMOS8 without parameter line

The timing of 8bits parallel digital video (without parameter line)are shown in Table 2-4, Table 2-5.

Table 2-4: 8bits video timing (without parameter line)(30HZ)

Video format	30Hz （Y16/YUV422）			30Hz （Y16+YUV422）		
Description	Typical value	Unit	Remarks	Typical value	Unit	Remarks
Resolution	640*512			1280*512		
NW	640			1280		
NH	512			512		
DIGITAL_CLK	21.75	MHz		43.5	MHz	
TLine	62.20	us	1352CLK	62.20	us	2704 CLK
TLine_Valid	58.85	us	1280 CLK	58.85	us	2560 CLK
TLine_Blank	3.34	us	72 CLK	3.34	us	144 CLK
TPixel	0.046..	us	1 CLK	0.023..	us	1 CLK
TStart	/	us	/	/	us	/
TFrame	33.33	ms	536 Line	33.33	ms	536 Line
TField_Valid	31.84	ms	512 Line	31.84	ms	512 Line
TField_Blank	1.49	ms	24Line	1.49	ms	24 Line

Table 2-5: 8bits video timing (without parameter line)(25HZ)

Video format	25Hz （Y16/YUV422）			25Hz （Y16+YUV422）		
Description	Typical value	Unit	Remarks	Typical value	Unit	Remarks
Resolution	640*512			1280*512		
NW	640			1280		
NH	512			512		
DIGITAL_CLK	21.75	MHz		43.5	MHz	
TLine	62.20	us	1352CLK	62.20	us	2704CLK
TLine_Valid	58.85.	us	1280 CLK	58.85	us	2560 CLK
TLine_Blank	3.34	us	72 CLK	16.18	us	144 CLK
TPixel	0.046..	us	1 CLK	0.023..	us	1 CLK
TStart	/	us	/	/	us	/
TFrame	40	ms	643 Line	40	ms	643 Line
TField_Valid	31.84	ms	512 Line	31.84	ms	512 Line
TField_Blank	8.16	ms	131 Line	8.16	ms	131 Line

The frame timing without parameter line for Y16/YUV422 is shown in Figure 2-2

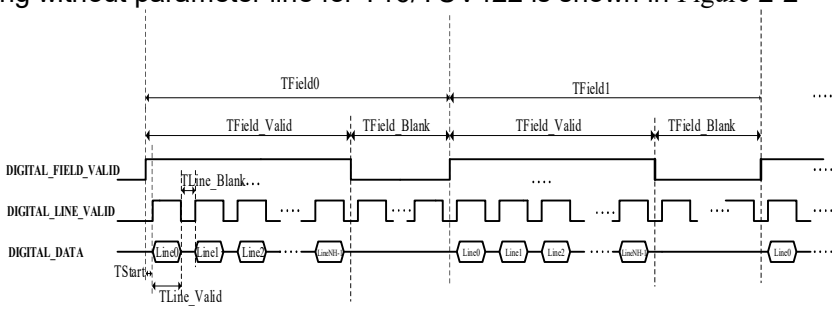


Figure 2-2 Y16/YUV422(without parameter line) timing diagram

The timing of 8bits parallel data for Y16 is shown in Figure 2-3.

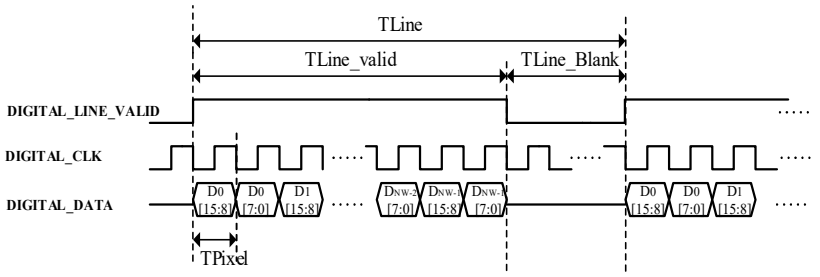


Figure 2-3a Y16 (MSB) timing diagram

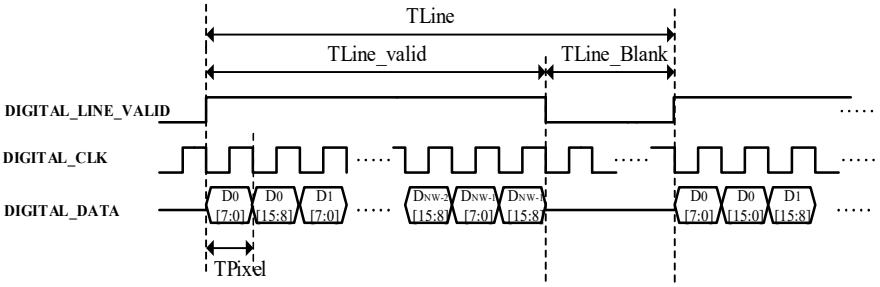


Figure 2-3b Y16 (LSB) timing diagram

The timing of 8bits parallel data for YUV422 is shown in Figure 2-4.

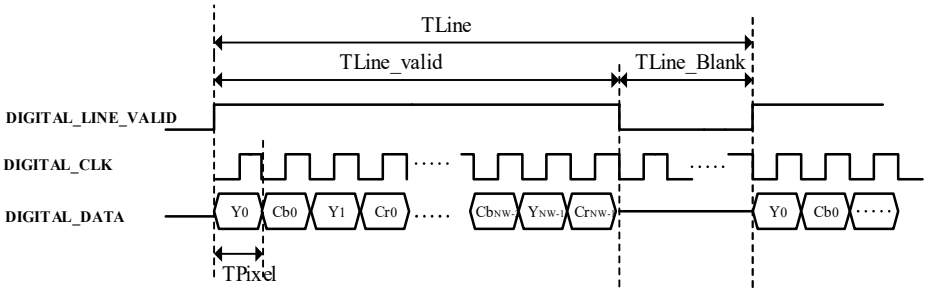


Figure 2-4a YUV422 (MSB) timing diagram

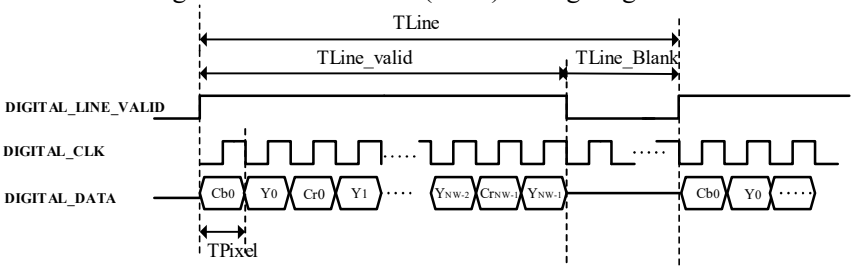


Figure 2-4b YUV422 (LSB) timing diagram

The row of the data source is YUV422 Y16 and the data timing diagram is shown in Figure 2-5.

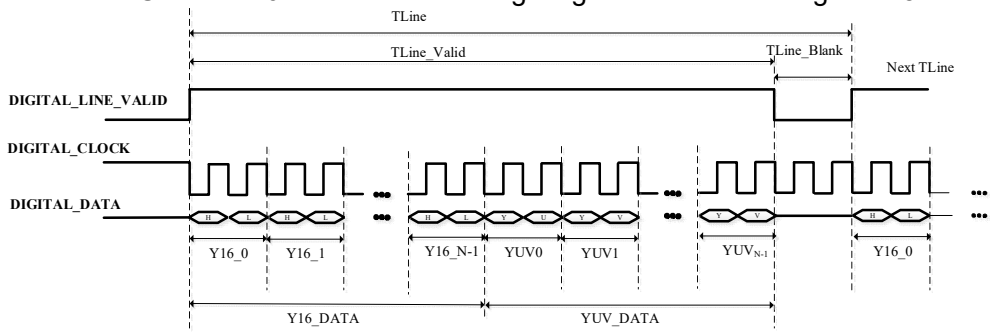


Figure 2-5a YUV422+Y16 (MSB) row and data sequence diagram

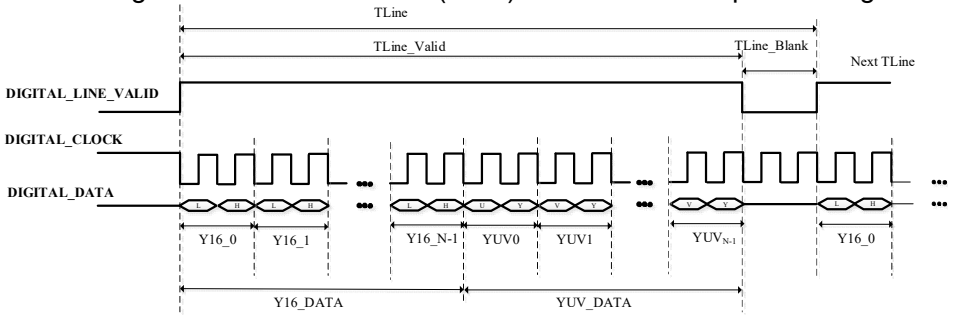


Figure 2-5b YUV422+Y16 (LSB) row and data sequence diagram

2.3.1.2 CMOS8 with parameter line

8bits parallel digital video timing parameters (with parameter line) are shown in Table 2-6, Table 2-7.

Table 2-6 Digital port 8bit sequence parameters (with parameter line)(30HZ)

Video format	30Hz （Y16/YUV422）			30Hz （Y16+YUV422）		
Description	Typical value	Unit	Description	Typical value	Unit	Description
Resolution	640*515			1280*515		
NW	640			1280		
NH	515			515		
DIGITAL_CLK	21.75	MHz		43.75	MHz	
TLine	62.20	us	1352CLK	62.20	us	2704 CLK
TLine_Valid	58.85	us	1280 CLK	58.85	us	2560 CLK
TLine_Blank	3.34	us	72 CLK	3.34	us	144 CLK
TPixel	0.046..	us	1 CLK	0.023..	us	1 CLK
TStart	/	us	/	/	us	/
TFrame	33.33	ms	536 Line	33.33	ms	536 Line
TField_Valid	32.01	ms	515 Line	32.01	ms	515 Line
TField_Blank	1.32	ms	21 Line	1.32	ms	21 Line

Table 2-7 Digital port 8bit sequence parameters (with parameter line)(25HZ)

Video format	25Hz （Y16/YUV422）			25Hz （Y16+YUV422）		
Description	Typical value	Unit	Remarks	Typical value	Unit	Remarks
Resolution	640*515			1280*515		
NW	640			1280		
NH	515			515		
DIGITAL_CLK	21.75	MHz		43.5	MHz	
TLine	62.20	us	1352CLK	62.20	us	2704CLK
TLine_Valid	58.85.	us	1280 CLK	58.85	us	2560 CLK

TLine_Blank	3.34	us	72 CLK	16.18	us	144 CLK
TPixel	0.046..	us	1 CLK	0.023..	us	1 CLK
TStart	/	us	/	/	us	/
TFrame	40	ms	643 Line	40	ms	643 Line
TField_Valid	32.01	ms	515 Line	32.01	ms	515 Line
TField_Blank	7.99	ms	128 Line	7.99	ms	128 Line

The frame timing of 8bits parallel data for Y16/YUV422 with parameter line is shown in Figure 2-6.

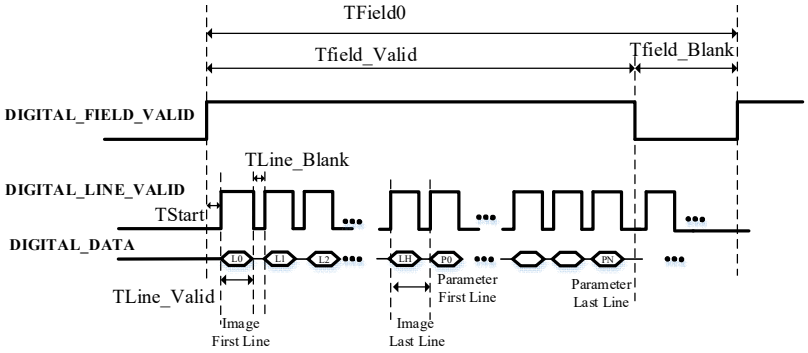


Figure 2-6 Y16/YUV422 + parameter line timing diagram

The timing of 8bits parallel data for Y16 + parameter line is shown in Fig. 2-7.

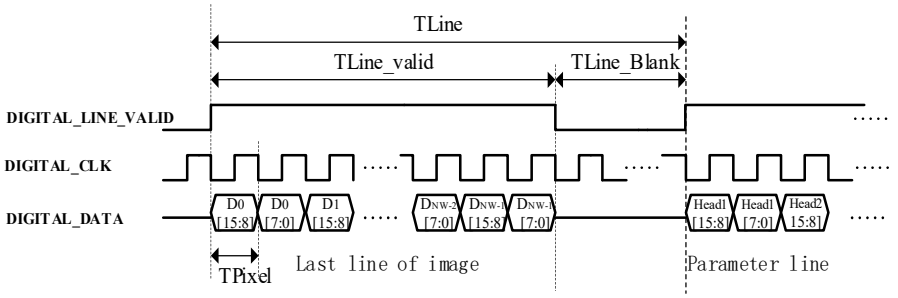


Figure 2-7a Y16+ parameter line (MSB) timing diagram

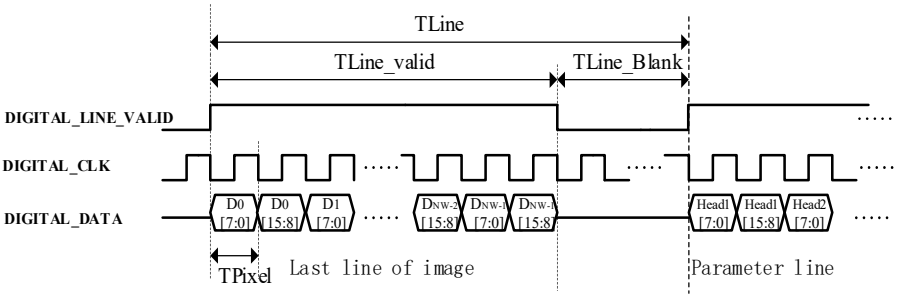


Figure 2-7b Y16+ parameter line (LSB) timing diagram

The timing of 8bits parallel data for YUV422 + parameter line is shown in Fig. 2-8.

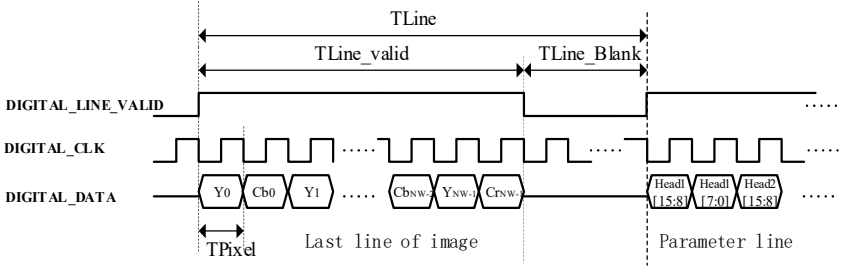


Figure 2-8a YUV422+ parameter line (MSB) timing diagram

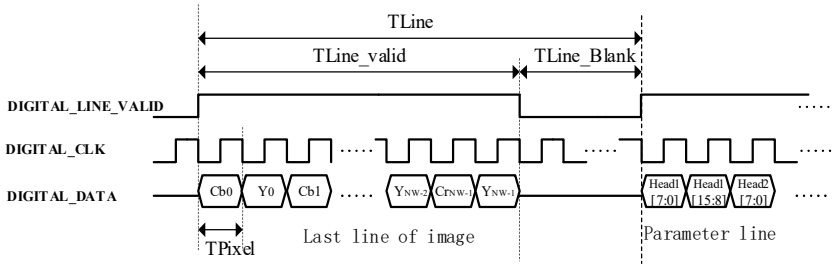


Figure 2-8b YUV422+ parameter line (LSB) timing diagram

The timing diagram of the data source as the Y16 parameter line YUV422 is shown in Figure 2-9 (CMOS8):

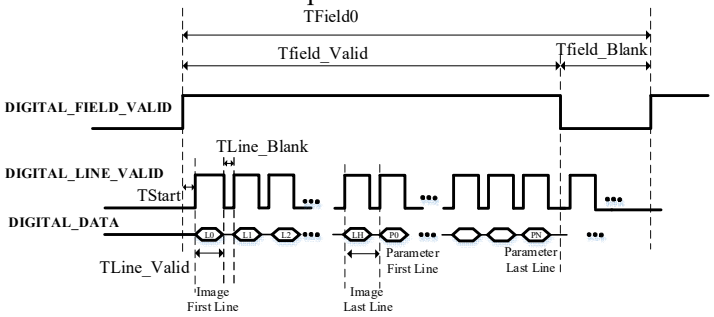


Figure 2-9a Line timing diagram of the a YUV422+Y16+ parameter line

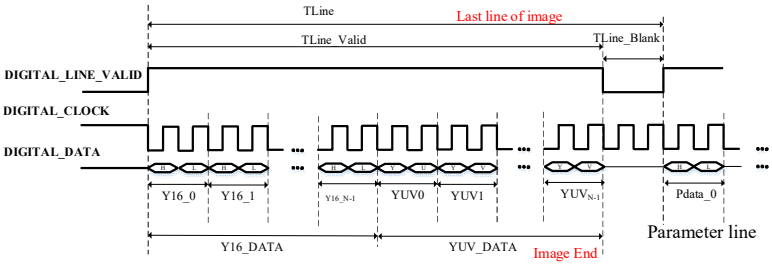


Figure 2-9b YUV422 +Y16 (MSB)+ parameter line

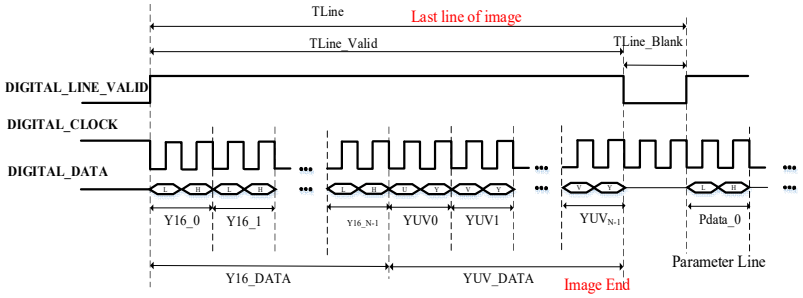


Figure 2-9c YUV422 +Y16 (LSB)+ parameter line

2.3.2 16bits parallel data (CMOS16)

2.3.2.1 CMOS16 without parameter line

The timing parameters of 16bits parallel data are shown in Table 2-8, Table 2-9.

Table 2-8 16bits parallel data timing parameters 1(without parameter line) (30HZ)

Video format	30Hz （Y16/YUV422）			30Hz （Y16+YUV422）		
Description	Typical value	Unit	Remarks	Typical value	Unit	Remarks
Resolution	640×512			1280*512		
NW	640			1280	/	/
NH	512			512	/	/

DIGITAL_CLK	10.875	MHz		21.75	MHz	/
TLine	62.20	us	676CLK	62.20	us	1352 CLK
TLine_Valid	58.85	us	640 CLK	58.85	us	1280 CLK
TLine_Blank	3.34	us	36 CLK	3.34	us	72 CLK
TPixel	0.092..	us	1 CLK	0.046..	us	1 CLK
TStart	/	us	/	/	us	/
TFrame	33.33	ms	536 Line	33.33	ms	536 Line
TField_Valid	31.84	ms	512 Line	31.84	ms	512 Line
TField_Blank	1.49	ms	24Line	1.49	ms	24 Line

Table 2-9 16bits parallel data timing parameters 1(without parameter line)(25HZ)

Video format	25Hz （Y16/YUV422）			25Hz （Y16+YUV422）		
Description	Typical value	Unit	Remarks	Typical value	Unit	Remarks
Resolution	640*512			1280*512		
NW	640			1280		
NH	512			512		
DIGITAL_CLK	10.875	MHz		21.75	MHz	
TLine	62.20	us	676CLK	62.20	us	1352 CLK
TLine_Valid	58.85	us	640 CLK	58.85	us	1280 CLK
TLine_Blank	3.34	us	36 CLK	3.34	us	72 CLK
TPixel	0.092	us	1 CLK	0.046..	us	1 CLK
TStart	/	us	/	/	us	/
TFrame	40	ms	643 Line	40	ms	643 Line
TField_Valid	31.84	ms	512 Line	31.84	ms	512 Line
TField_Blank	8.16	ms	131 Line	8.16	ms	131 Line

The frame timing of 16bits parallel data for Y16/YUV422 is shown in Figure 2-10.

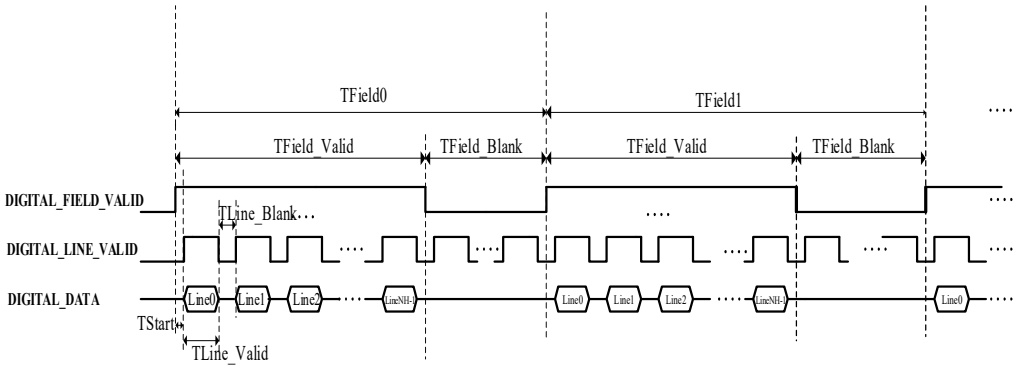


Figure 2-10 CMOS16, 16bits parallel data without parameter line timing diagram

The timing of 16bits parallel data for Y16 is shown in Figure 2-11.

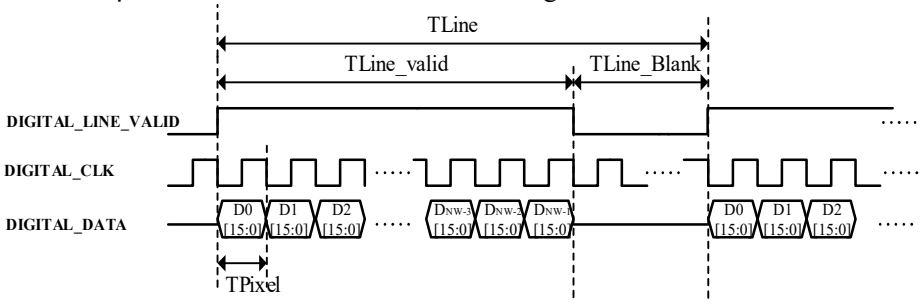


Figure 2-11 CMOS16, Y16 timing diagram

The timing of 16bits parallel data for YUV422 is shown in Figure 2-12.

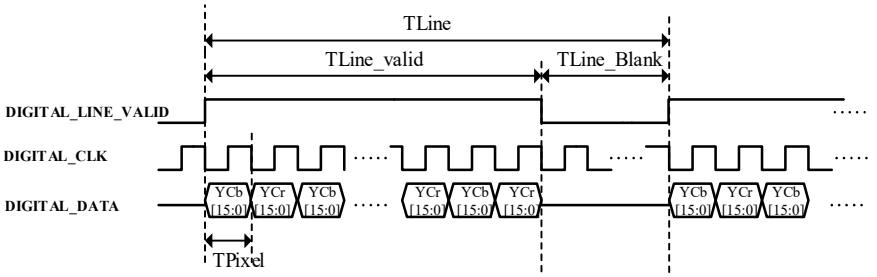


Figure 2-12 CMOS16, YUV422 timing diagram

The timing of row and data timing with YUV422+Y16 is shown in Figure 2-13.

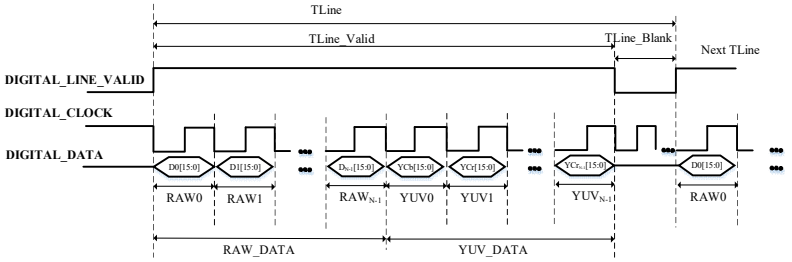


Figure 2-13 CMOS16 YUV422 +Y16 row and data time sequence diagram

2.3.2.2 CMOS16 with parameter line

16bits parallel data (including parameter line) timing parameters are shown in Table 2-10, Table 2-11.

Table.2-10 16bits parallel data timing parameters 1 (with parameter line)(30HZ)

Video format	30Hz （Y16/YUV422）			30Hz （Y16/YUV422）		
Description	Typical value	Unit	Description	Typical value	Unit	Description
Resolution	640*515			1280*515		
NW	640			1280	/	/
NH	515			515	/	/
DIGITAL_CLK	10.875	MHz		21.75	MHz	/
TLine	62.20	us	676CLK	62.20	us	1352CLK
TLine_Valid	58.85	us	640CLK	58.85	us	1280CLK
TLine_Blank	3.34	us	36CLK	3.34	us	72 CLK
TPixel	0.092..	us	1 CLK	0.046..	us	1 CLK
TStart	/	us	/	/	us	/
TFrame	33.33	ms	536 Line	33.33	ms	536 Line
TField_Valid	32.01	ms	515 Line	32.01	ms	515 Line
TField_Blank	1.32	ms	21 Line	1.32	ms	21 Line

Table.2-11 16bits parallel data timing parameters 1 (with parameter line)(25HZ)

Video format	25Hz （Y16/YUV422）			25Hz （Y16+YUV422）		
Description	Typical value	Unit	Remarks	Typical value	Unit	Remarks
Resolution	640*515			1280*515		
NW	640			1280		
NH	515			515		
DIGITAL_CLK	10.875	MHz		21.75	MHz	
TLine	62.20	us	676CLK	62.20	us	1352 CLK
TLine_Valid	58.85	us	640 CLK	58.85	us	1280 CLK
TLine_Blank	3.34	us	36 CLK	3.34	us	72 CLK
TPixel	0.092	us	1 CLK	0.046..	us	1 CLK
TStart	/	us	/	/	us	/
TFrame	40	ms	643 Line	40	ms	643 Line

TField_Valid	32.01	ms	515Line	32.01	ms	515Line
TField_Blank	7.99	ms	128 Line	7.99	ms	128 Line

The frame timing of 16bits parallel data for Y16/YUV422 with parameters line is shown in Figure 2-14.

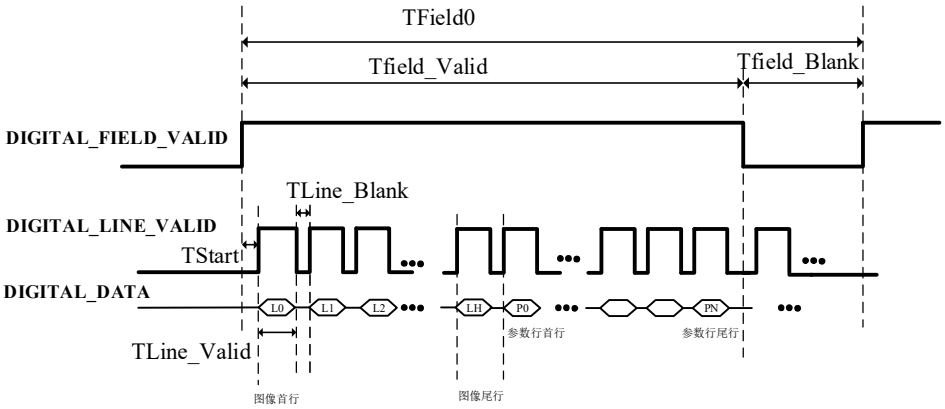


Figure 2-14 Y16/YUV422+parameter frame timing diagram

The timing of 16bits parallel data for Y16 with parameters line is shown in Figure 2-15.

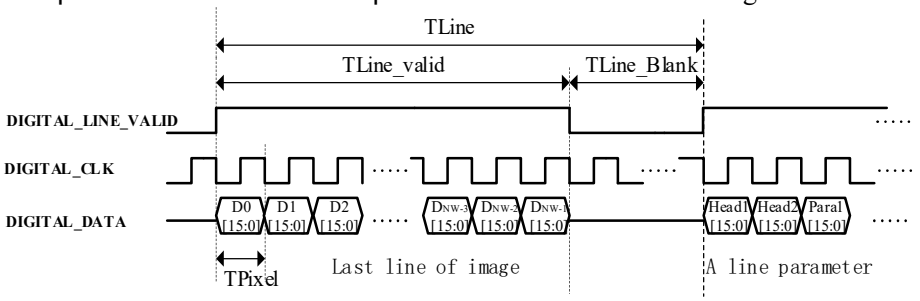


Figure 2-15 CMOS16 Y16+parameter timing diagram

The timing of 16bits parallel data for YUV422 with parameters line is shown in Figure 2-16.

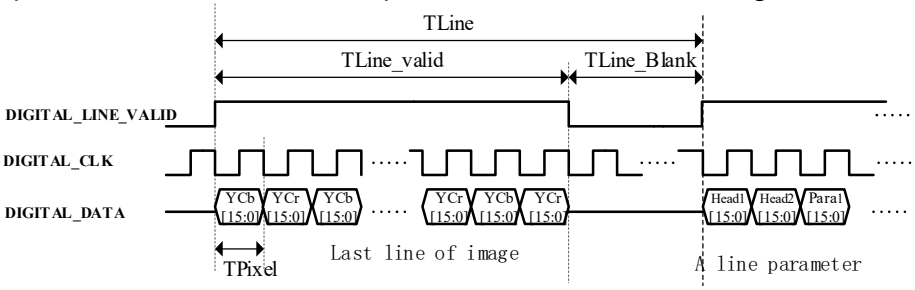


Figure 2-16 CMOS16, YUV422+parameter timing diagram

The timing of row and data timing graph with YUV422 Y16 parameter lines is shown in Figure 2-17.

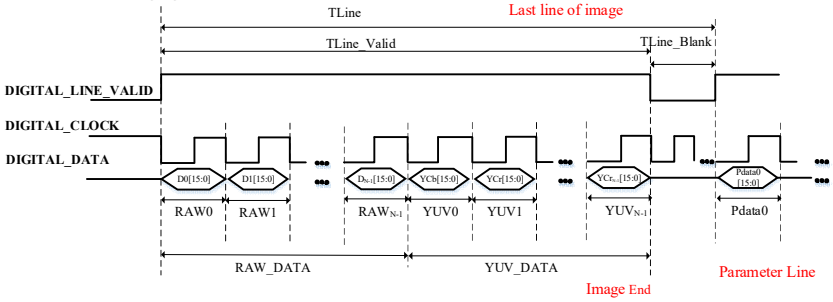


Figure 2-17 CMOS16 YUV422+Y16+parameter row and data timing diagram

2.3.3 Description of BT.656 format

The BT.656 interface output data are standard BT.656 format.

1) Data format: Cb, Y, Cr, Y or Y, Cb, Y, Cr 8bit.

2) Progressive mode is supported, interlaced mode is not supported.

3) Bt.656 can be configured based on the resolution size to customize the number of hidden and total rows.

4) Only support frame transmission, the same frame does not support two field transmission.

5) Internal synchronization of BT.656: the figure below shows the format of Internal synchronization.

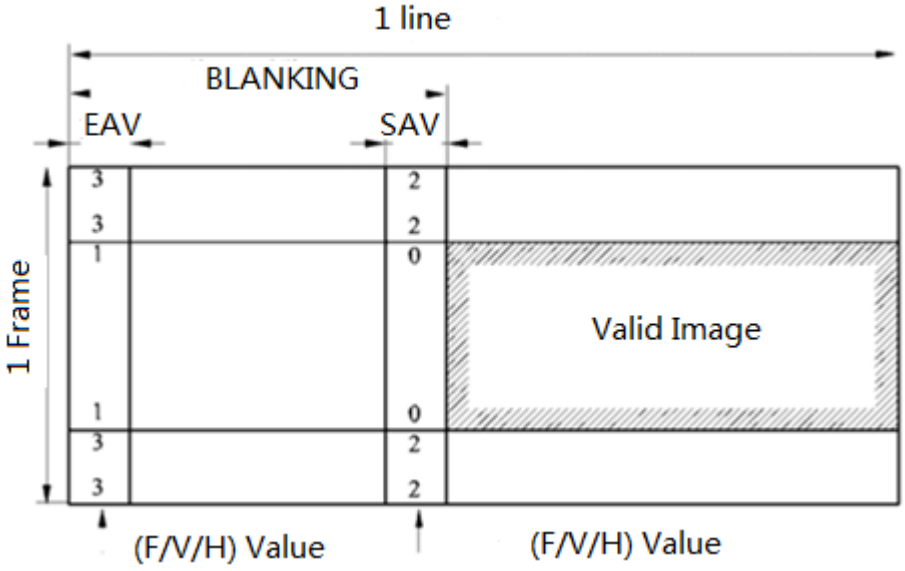
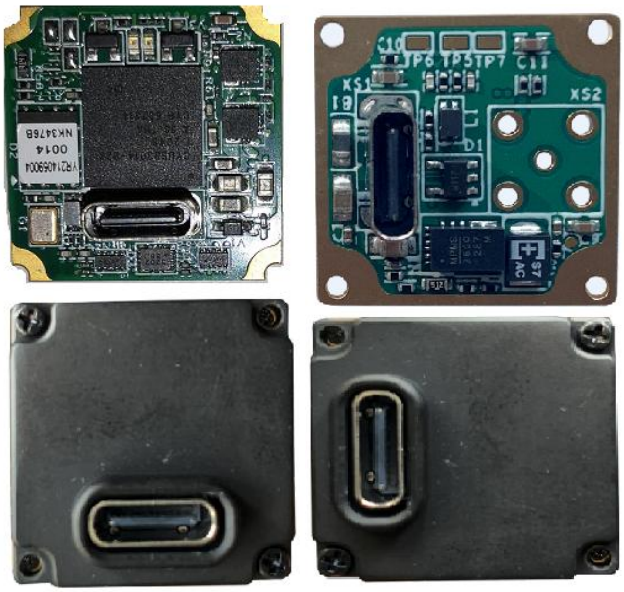


Figure 2-18: BT.656 interface output data format

3 Optional Accessories

Type-C VPC borad

Adapter +Video cable + Micro USB cable



Type-C USB2.0 board　　Type-C USB3.0 board

3.1　VPC expansion board

3.1.1　Feature of the board

- Type-C USB interface.
- Steady current≤300mA@5V, transient starting current≤500mA@5V.
- Serial baud rate: 115200(8N1).
- analog video output, 75Ω characteristic impedance.
- Hot swap protection.

3.1.2　Application instruction for VPC board

VPC board has two external interfaces: analog video interface and Type-C USB interface.

The user can use the optional video extension cable for the application of external analog video, with one terminal (MCX terminal) connected to the module and the other terminal connected to the AV interface of monitor.

The user can also use the optional USB cable or mobile phone USB cable with rated current over 1A , with one terminal connected to the Type-C USB interface of the module and the other terminal connected to the USB interface of the computer.

After the ICC control software is installed on the computer, the connection between the module and the ICC software can be realized through the USB cable. For the installation instructions of the ICC control software, please refer to ICC related instructions .

3.2　USB2.0 expansion board

3.2.1　Feature of the board

- Standard type-C interface interface;
- Steady state current ≤350mA@5V, Starting transient current ≤500mA@5V(with the module);
- Serial baud rate:115200;
- Supporting UVC video transmission protocol;
- Support USB port hot plug protection;

3.2.2 Application description

USB2.0 expansion board is a digital video acquisition board for TWIN612 standard infrared thermal imaging movement. It adopts USB2.0 standard and type-c interface. It supports digital video transmission and serial port control. It is portable, universal and easy to develop and integrate.

ICC (infrared camera controller) software is supported. The movement can be configured and the digital video output can be viewed through the control software. ICC software version 1.3.0 and above.

Operating system: support Windows 7 / 8 / 10 / XP, etc.

Language environment: support Chinese / English, etc.

For detailed application method, please refer to "USB expansion board instructions - v1.0".

3.3 USB3.0 expansion board

3.3.1 Feature of the board

- Standard type-C interface interface;
- Steady state current≤350mA@5V, Starting transient current ≤500mA@5V(with the module);
- Serial baud rate:115200;
- Supporting UVC video transmission protocol;
- Support USB port hot plug protection;

3.3.2 Application description

USB3.0 expansion board is a digital video acquisition board for TWIN612 standard infrared thermal imaging movement. It adopts USB3.0 standard and type-c interface. It supports digital video transmission and serial port control. It is portable, universal and easy to develop and integrate.

ICC (infrared camera controller) software is supported. The movement can be configured and the digital video output can be viewed through the control software. ICC software version 1.3.0 and above.

Operating system: support Windows 7 / 8 / 10 / XP, etc.

Language environment: support Chinese / English, etc.

For detailed application method, please refer to "USB expansion board instructions - v1.0".

4 ICC control software

4.1 Installation instructions

This chapter mainly describes the installation method, steps and precautions of the infrared module software to achieve the normal use of the installed software.

1.Firstly, double-click the application installation file 

for installation to pop up an installation window, click the button "Next" for installation at the next step, as shown in Figure 4-1.

Figure 4-1 Software installation interface 1

2.Click the button "Next" to pop up a window for selection of installation path and the installation object. After selecting the file installation path and object, click the button "Next" to proceed to the next step, as shown in Figure 4-2.

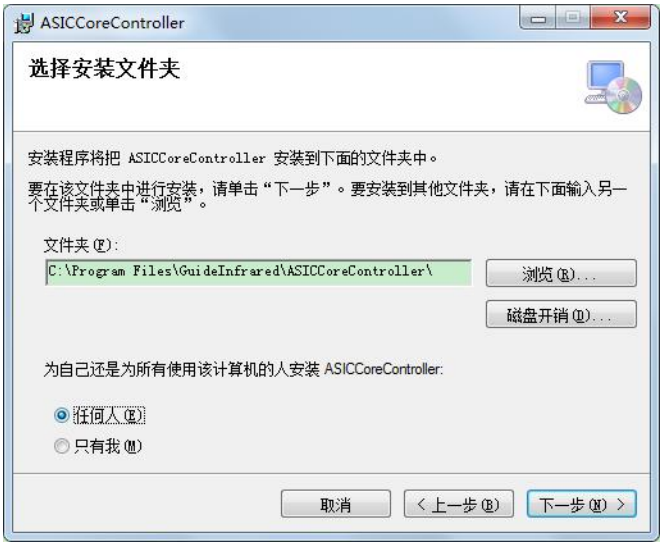


Figure 4-2 Software installation interface 2

3.In the new pop-up window, click the button "Next" to proceed to the next step, as shown in Figure 4-3.

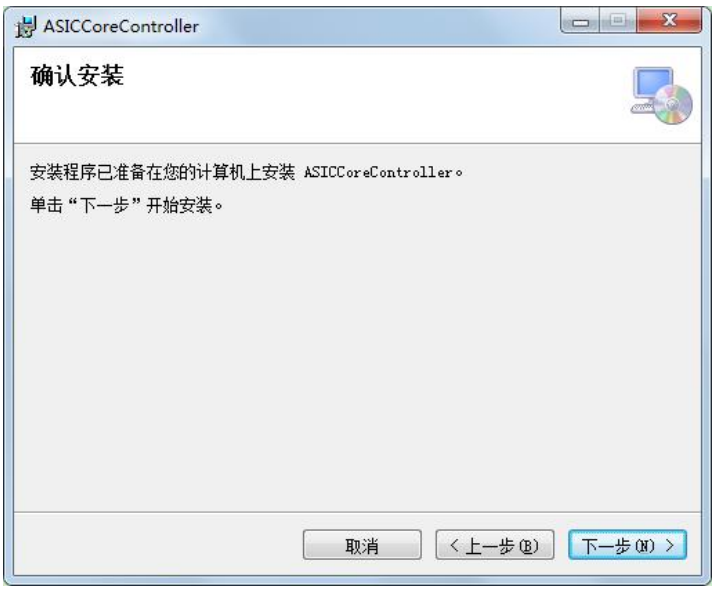


Figure 4-3 Software installation interface 3

4.During installation, the installation progress interface will appear, please wait for the installation to complete, as shown in Figure 4-4.

Figure 4-4 Software installation interface 4

5. After the installation, two windows will pop up, one is the window for installation complete, and other one is window for USB driver, as shown in Figure 4-5 and Figure 4-6 respectively.

Figure 4-5 Pop-up window for software installation complete

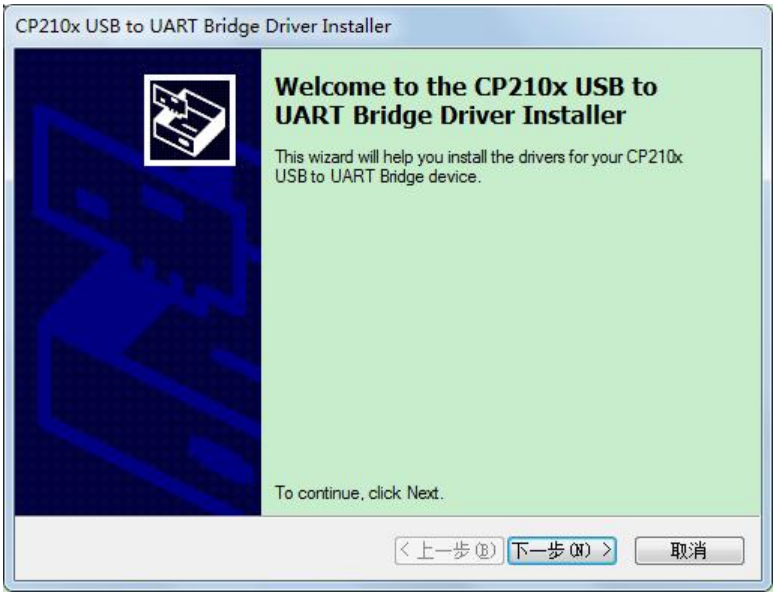


Figure 4-6 Pop-up window for USB driver installation

6. Click the button "Close" in Figure 4-5 to complete the module software installation, and then click the button "Next" in Figure 4-6 for USB driver installation, at which time, an agreement selection window as shown in Figure 4-7 will pop up.

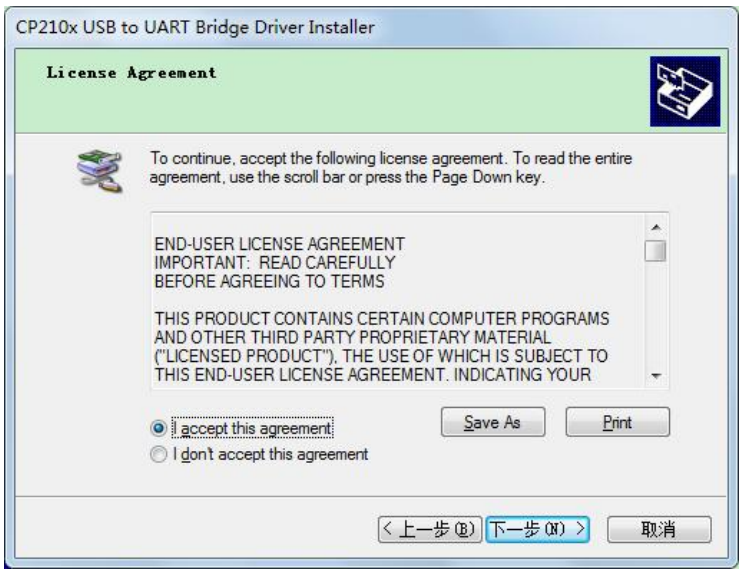


Figure 4-7 Agreement selection window

7. Select the button "I accept this agreement" and click the button "Next" to continue the installation.

8. During installation, the installation progress interface will appear, please wait for the installation to complete, as shown in Fig. 4-8.

Figure 4-8 Installing window

9. Upon USB driver installation, an installation complete window as shown in Figure 4-9 will pop up.

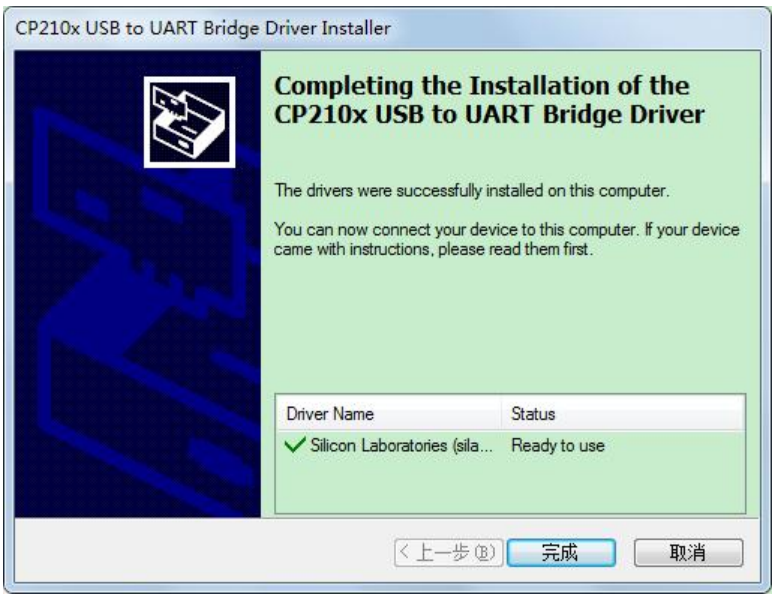


Figure 4-9 Pop-up window for USB installation complete

10. Click the button ”Finish”, installation complete, quit the installation.

4.2 Interconnection between module and PC control software

This chapter describes how to use the infrared module software to connect the PC and the module through a USB cable.

1. Click the desktop icon or click the " ASIC Core Controller " in "Start" to start the infrared module software.

2. When the software is opened for the first time, the connection wizard interface is an English interface by default, the upper left corner shows that the current connection status is "NotConnected", and the upper right corner shows the software version number, as shown in Figure 4-10.

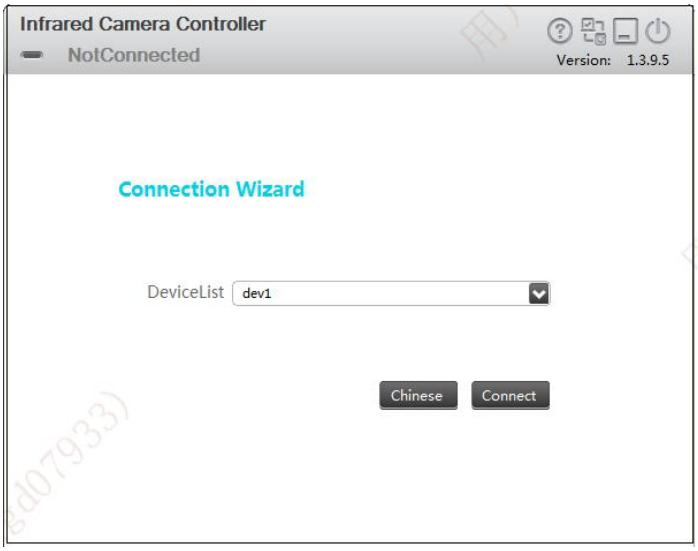


Figure 4-10 Connection wizard interface

3. Click the icon in the upper left corner to display the software instructions;

Click the icon to switch to the connection wizard interface;

Click the icon to hide the window in the taskbar;

Click the icon to close the software.

4. Operation instructions of PC control software

After the module and PC control software are connected successfully, the module enters the operation interface. The functions and operation method of the interface will be described in the following section.

4.2.1 Status

This chapter mainly describes the parameters and performance status of the module connected at present.

1. Click the "Connect" to communicate with the module successfully, and then allow the software to enter the module status interface. The upper left corner of the interface shows the current connection status and module type, as shown in Figure 4-11.

Figure 4-11 Module status interface

2. The interface shows the module information, including name, shape, detector type, wavelength, resolution, function, input voltage, communication protocol and machine code., etc. The program version number, focal plane array temperature, and current communication baud rate of the slave are also displayed at the bottom of the interface.

4.2.2 Settings

This chapter mainly describes the setting of the shutter including compensation interval time, Image mode including image freeze, all kinds of test image.

Click the setting menu on the left side of the interface to enter the module settings interface as shown in Figure 4-12.

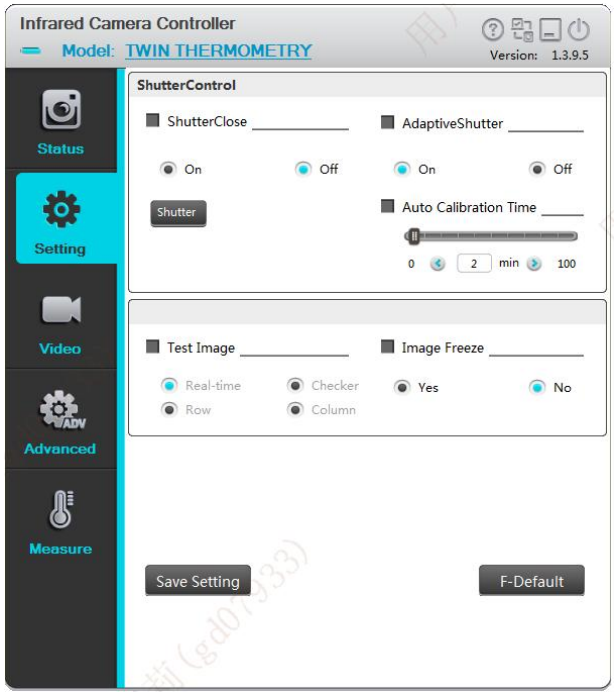
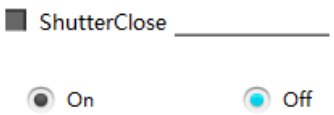
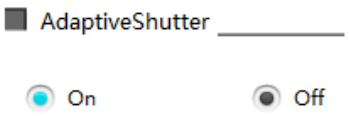


Figure 4-12 Module settings interface

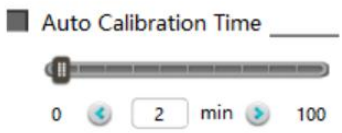
Shutter closure: When the shutter closure is closed, select Shutter Compensation button to do shutter compensation.



Adaptive compensation: on or off.



Automatic compensation time: Set the time interval (in minutes) of automatically opening the shutter. When the module is just started and the focal plane temperature is not stable, the time interval may be short. After the focal plane temperature is stable, you can extend the time interval properly.



Test Image: the test patterns include real-time、checker, row and column scanning pattern. The twin412 only supports real-time test screens by default.

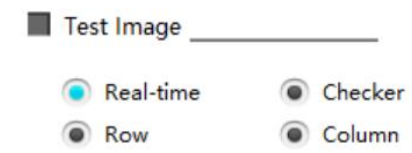
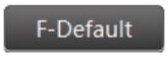


Image freeze: For the analog video scene of interest, you can select “Yes” to freeze the infrared scene image. Then the infrared image of the analog video output will not change as the scene does, allowing users to watch the scene of interest. You can choose “No” to unfreeze, to observe real-time changes in the scene.

Save settings: After using the Infrared Camera Controller ICC to change the module mode and parameter values, click the button "Save Settings" 

to save the current configuration as the new power-on default. When powering on the module at the next time, the module will be configured with the new power-on default. If you do not save the settings, the change made by ICC is only valid for the current stage, and the module will be configured based on the previous default at the next boot.

Factory reset: Press the button “Factory Reset” 

to restore module's all configurations to the factory defaults.

4.2.3 Video

This section describes the parameters adjustment and image processing of analog video, digital video and other related algorithms in detail.

4.2.3.1 Setting interface of analog video

Click the video menu on the left side of the interface, and enter the analog video setting interface, as shown in Fig. 4-13.

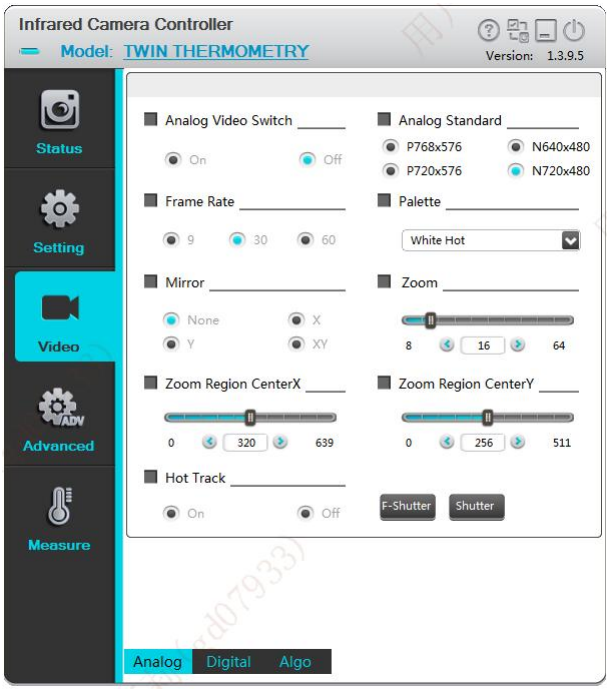
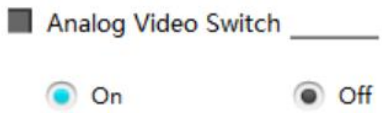


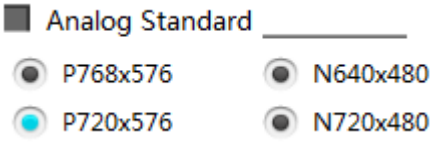
Figure 4-13 The setting interface of analog video

The analog video page mainly includes: analog video switch, system selection, frame rate setting, polarity/pseudo-color, mirror and zoom setting.

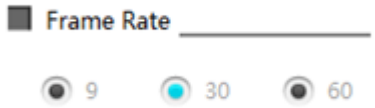
Analog video switch: If the analog video display is not needed in the application, you can set the switch “off” to turn off the analog video to reduce 200mW power consumption. The is “on” by default.



Video system: Choose the video system to output. The module provides two video systems: PAL (video resolution 768×576/720×576, valid resolution 640×512) and NTSC (video resolution 640×480/720×480, valid resolution 640×480). Different output systems correspond to different digital and analog video frame rate. After changing the video system, the module needs to be restarted after shut down.



Frame rate: Select the frame rate of the analog video output for the module. If the module is working under PAL system, the frame rate of the analog video can be set to 25Hz. If the module is working under NTSC system, the frame rate of the analog video can be set to 30Hz. The lower the frame rate is, the lower the frequency needed to discover analog video motion is.



Polarity/pseudo color: The module detects and images the temperature, and maps the temperature to the range between 0 and 255. In black white mode, the gray scale 0 is shown as solid black and the gray scale 255 is shown as white. In the gray scale range of 0~255, color mapping can be performed through the internal lookup table, and different lookup table represent different ribbons. The modes black hot (darker represents hotter) and white hot (whiter represents hotter) are often selected, and such simple temperature black white mapping is also known as polarity. Color mapping can also be performed through the color lookup table. The module provides totally nine color mapping, including white hot and black hot, which are suitable for analog and digital video.

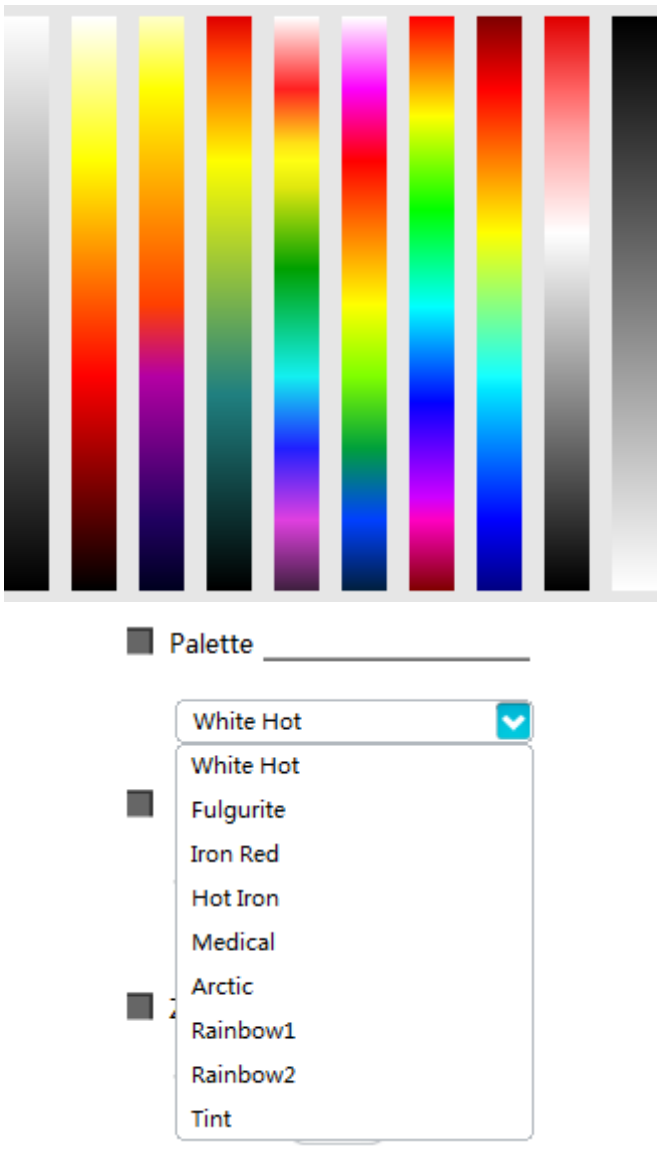


Figure 4-14 Pseudo-color table

Zoom: 8~64 Optional, step is 1.

4.2.3.2 The digital video

Click digital video menu at the bottom of Fig. 4-13, and enter the digital video setting interface, as shown in Fig. 4-15.

Figure 4-15 The setting interface of digital video

Digital video page is mainly used to achieve the related settings of digital video, such as external synchronization (slave mode) switch, digital port switch, digital port type, CMOS content, CMOS interface, digital frame rate and LVDS switch .

External synchronization: the movement external synchronization from the mode switch.

Slave: When the module is working, start external synchronization mode. If the external synchronization trigger signal is detected, that is, output video according to the external synchronization signal after the end of the current field. If the external synchronization signal is not detected, execute it in the last cycle.

The specific timing can be designed according to the actual situation.

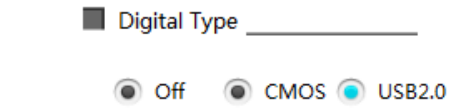
Off: the movement works in self-synchronous mode, normal output video.

Main: The output field periodic signal is used for external synchronization.

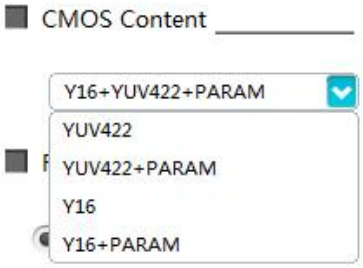
Digital port type: select the output format of digital parallel port, including CMOS and USB2.0.

If you select CMOS, you also need to configure the select CMOS content and CMOS interface options.

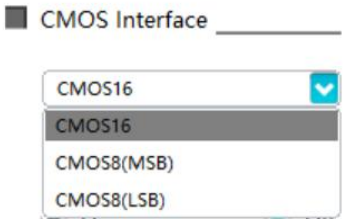
If you select the USB2.0, the digital port will directly output the USB2.0 video.



CMOS content: To select CMOS content. The CMOS content can only be configured when the digital port type option is “CMOS”. CMOS content can be set as follows, and please refer to Section 2.3 for the digital port output timing. Each time you change the CMOS content, reopen the digital port for the changes to take effect.



CMOS interface: To select CMOS interface. The CMOS content can only be configured when the digital port type option is “CMOS”. The CMOS interface selection is as follows, and please refer to Section 2.3 for the digital port output timing. Except for the interface CMOS16, the other two interfaces can’t support the real time video display.



Frame rate: To set the digital video CMOS type output frame rate.

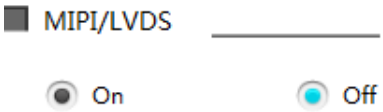
If the Firmware version is 25/30hz, the frame rate of digital video can be set to 30Hz, 25Hz and 9Hz.

If the Firmware version is 50/60hz , the frame rate of digital video can be set to 60Hz, 50Hz and 9Hz.

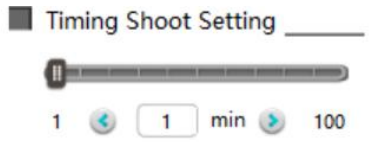
The smaller the frame frequency setting of digital video is, the smaller the frame frequency of the field synchronization signal can be detected..

Clock phase: default posedge.

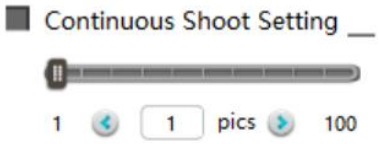
MIPI/LVDS: LVDS switch setting. When setting to “On”, the module will output standard LVDS timing from the fixed interface. The default setting is “Off”.



Time-lapsed photography interval: Set the time interval for the software to take photos of the captured video in unit of min.



Number of continuous shooting: Set the number of pictures taken from the captured video by the software.



Scene compensation: Click the button F-Shutter to capture the current scene data for non-uniformity correction.

Shutter compensation: Click the button Shutter to control the shutter close and to collect the shutter data for non-uniformity correction.

Shooting: Click the Slap button to take a screenshot of the current scene, and the picture is named after the current time and saved in the selected folder. The format of saved photo files is bmp or raw, based on the digital port.

Continuous shooting: Click the MultSlap button to take a continuous picture of the video. According to the number value set by the "number of continuous shooting", take pictures of the current scene. The picture is named after the current time and saved in the selected folder. The format of saved photo files is bmp or raw, based on the digital port.

Time-lapsed photography: Click the T-Slap button for timed photographing. The module will take pictures with the time interval you've set. The picture is named after the current time and saved in the selected folder. The format of saved photo files is bmp or raw, based on the digital port.

Video: Click the Record button to begin videoing after the button brightens; click again, the button returns to normal state and it will stop videoing; Video files are named after the current time and saved in the selected folder. The format of saved video files is raw, based on the digital port.

4.2.3.3 Algorithm

Click the algorithm menu at the bottom of Figure 4-15, and enter the algorithm setting interface 1, as shown in Figure 4-16.

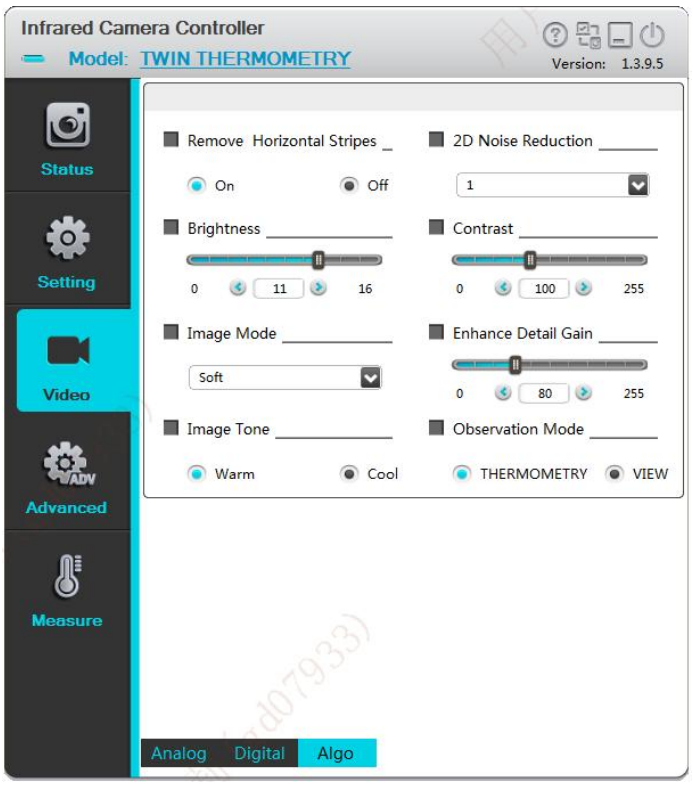
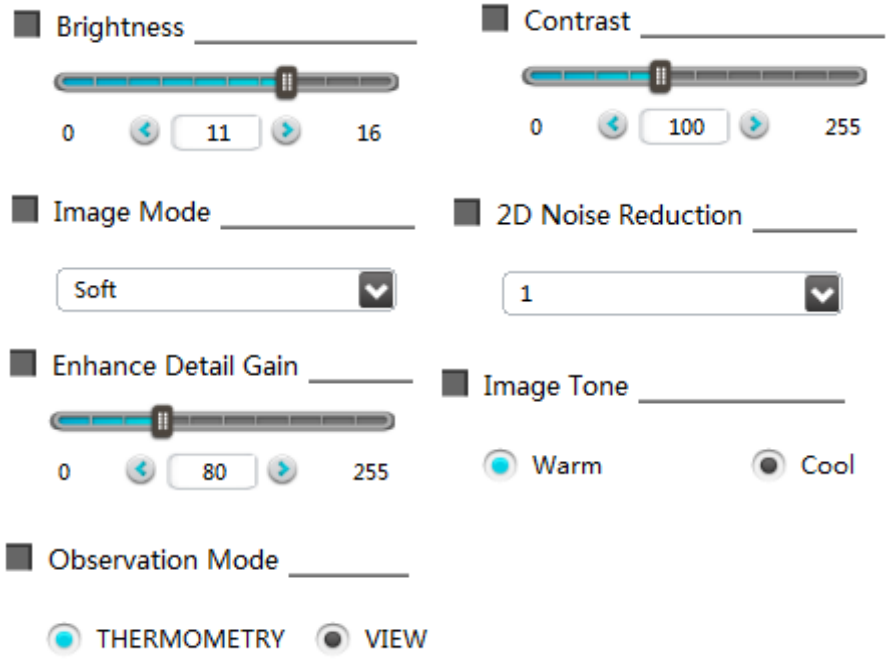


Figure 4-16 The algorithm setting interface 1

Brightness: Reflect the overall brightness of the image and adjust as a percentage. The larger the value is, the brighter the image will be.

Contrast: Reflect the overall size of the image contrast and adjust as a percentage. The larger the value is, the stronger the contrast will be.

Note. When Y8 correction is in automatic mode, brightness and contrast cannot be adjusted; When Y8 correction is in manual mode, brightness contrast can be adjusted.



4.2.4 Advanced Application

This chapter focuses on the advanced application operation of the module, including focusing, defective

pixel treatment, menu superposition and so on.

4.2.4.1 Focus setting interface

Click the advanced application menu at the left of interface, and enter the focus setting interface of advanced application, as shown in Figure 4-17.

This page mainly focus on the electric lens and updating program.

Figure 4-17 Advanced application interface

Focus： Unavailable for the module.

Updating program: Loading ". dat "file and select update type. Don't switch off during the updating program process

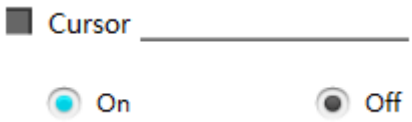
4.2.4.2 Defective pixel correction interface

Click the "Defective pixel" menu on the interface as shown in Figure 4-17, and enter the defective pixel correction interface of advanced application as shown in Figure 4-18.

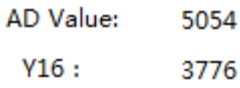
Figure 4-18 Defective pixel correction interface

On the defective pixel correction interface, imaging effects of the abnormal pixel of images can be corrected.

Cursor: Analog video cursor display switch. Cursor will be displayed at the corresponding location on the analog video when it is on. The cursor can be moved by adjusting the coordinates X and Y, or moved continuously via the arrow keys on keyboard. The AD sampling value of current coordinate point can also be displayed in real time.



AD value: display the AD sampling value of current coordinate to determine whether the current pixel is defective.



Y16: Displays the value of Y16 at the current coordinate

Coordinate X/Y: display the values of coordinate X/Y at current cursor location. The cursor can be moved continuously via Up and Down keys on the interface or arrow keys on the keyboard.

Adding defective pixels: For the defective pixels of the detector pixel, you can move the cursor to a defective pixel, and click the "Add Defective Pixel" button to replace the selected defective pixel with a new pixel to improve image quality.

Saving defective pixels: After addition and replacement of the defective pixels / defective rows / defective columns, you can click “Save Defective Pixel” button to save the defective pixels, and the module will remember the positions of the saved defective pixels and replace them when you reboot the machine. Without saving the new defective pixels, the changes made through ICC are only valid in the current stage and the original defective pixels will be displayed at the same positions when you reboot the machine.

Add defective rows: Adds the rows where the cursor on as defective pixels, complete the whole row of defective pixels replacement.

Add defective columns: Adds the columns where the cursor on as defective pixels, complete the whole column of defective pixels replacement.

4.2.4.3 Menu OSD

Unavailable for the module.

4.2.4.4 Hot tracking

Click the font area of "hot trace" in the interface of Figure 4-17 and the software enters the interface of hot analysis in advanced applications. The first page of hot analysis is shown in Figure 4-19.

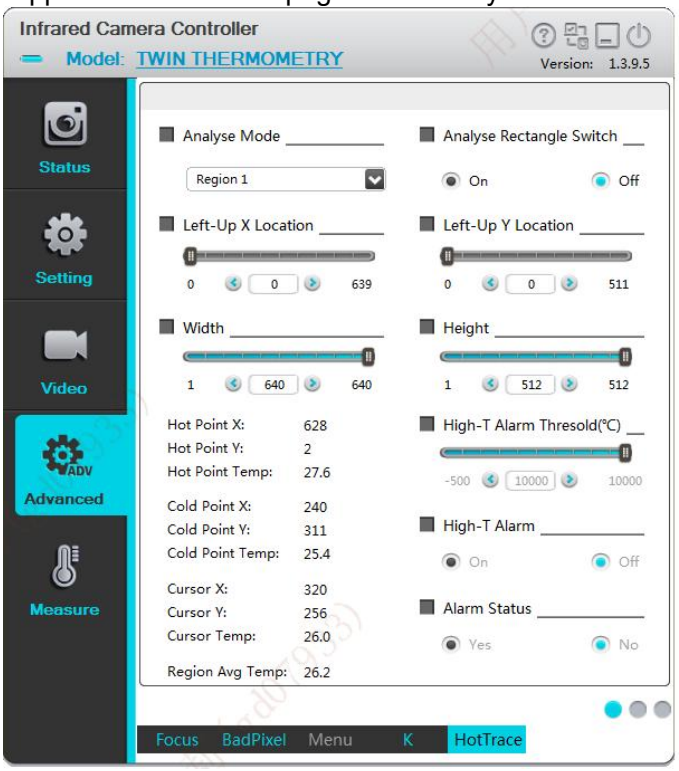
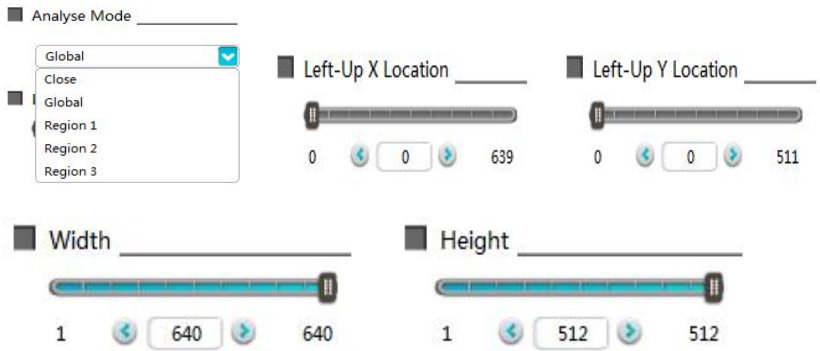


Figure 4-19 page 1 of Hot tracking

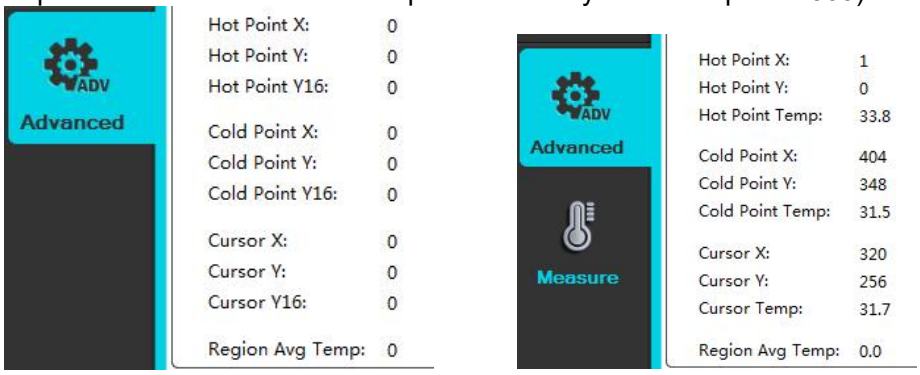
Analysis mode: region analysis mode selection



In the three regions of analysis mode, only one region can be selected for setting each time, but the parameters of three regions are independent. Three areas can not be displayed at the same time, also can not track or thermometry simultaneously. The area box displays off when you select analysis mode as off or full screen. After resetting the starting coordinates and width and height of the area, the area box displays the position, area tracking or thermometry immediately.

Analysis results display: the module is immediately tracked whether it is set to full screen or area. On

software to switch page or send the hot tracking first page query command, then get the tracked result, as shown in Figure 4-20, for observation module, can get the Y16 value of hottest spots, coldest spots, the cursor spots and their corresponding coordinate position, the last item is regional average Y16 value,for thermometry module, you can get the temperature of hottest spots, coldest spots and cursor spots and their corresponding coordinates position, the last item is the average temperature for area (please note that the temperature value from machines response page query command is the real-time temperature * 10, as shown below, for example, when display the hottest spot temperature is 30.9 degrees, The temperature value of the hottest spot returned by the serial port is 309)



a) Observation type b) Thermography type

Figure 4-20 result of area analysis

High temperature alarm： Unavailable for the module.

The third page of hotspot analysis is shown in f Figure 4-21

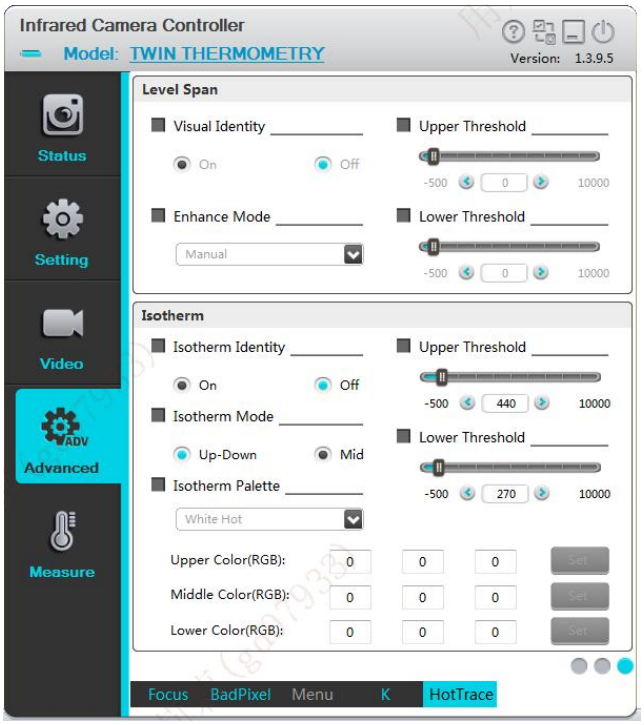
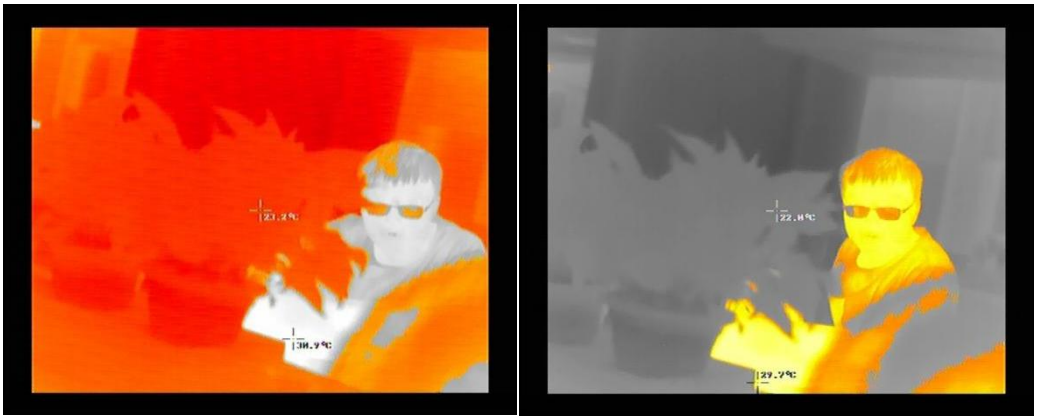


Figure 4-21 page 3 of Hot tracking

Isothermals: in grayscale image, the temperature interval or Y16 interval to be concerned should be highlighted with pseudo-color.

Up-Down: in this mode, pseudo-color is used to highlight the areas where the temperature or Y16 is higher than the upper limit threshold, and pseudo-color is used to highlight the areas where the temperature or Y16 is lower than the lower limit. The upper isotherm or lower isotherm mode can be realized by adjusting the threshold value.

Middle: In this mode, the areas where temperature or Y16 is larger than the upper threshold and smaller than the lower limit are highlighted with pseudo-color.



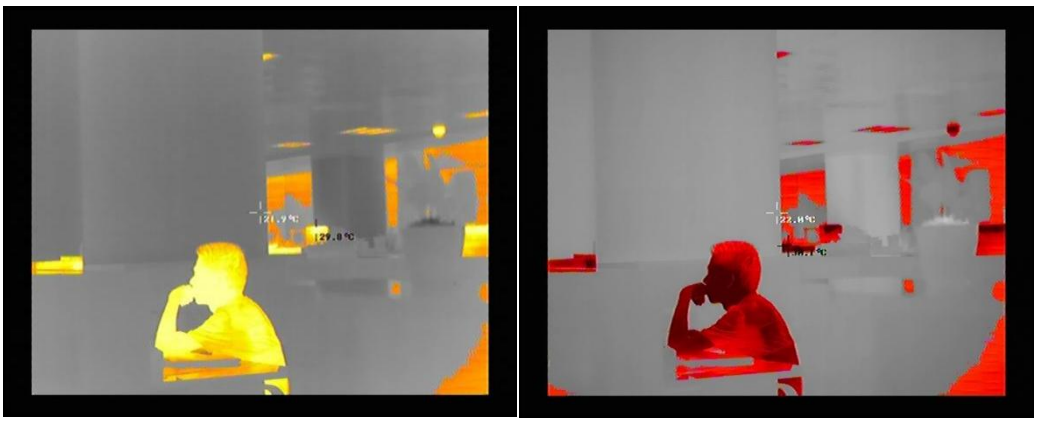
(a) (b)

Figure 4-22 Isothermals

Take the thermography type as an example, the upper limit threshold is 39.0℃, the lower limit threshold is 29.0℃, FIG. a shows the upper and lower isothermal mode, and the scene beyond 29~39℃ is represented by fulgurite pseudo-color. FIG. b shows the scene in the medium isotherm mode within 29~39℃ represented by fulgurite pseudo-color.

Isothermal color: isothermal pseudo-color can be selected by isothermal pseudo-color belt selection command. Currently, 10 isothermal pseudo-colors including white hot, fulgurite, iron red, hot iron, medical treatment, arctic, rainbow 1, rainbow 2, trace red and black hot are supported by default.

Isothermal polarity: when the isotherm function is switch on, setting the polarity pseudo-color on the page invalid, but the black/white polarity of the isotherm can be changed by sending black and white pseudo-color modes.



(a) (b)

Figure 4-23 Isotherm polarity switching

Taking thermography type as an example, the upper limit threshold is 39.0℃, the lower limit threshold is 29.0℃, and FIG. a shows the white-hot Fulgurite isotherm. FIG.b shows the black-hot Fulgurite isotherm.

4.2.5 Thermography

On the parameters setting interface, the parameters related to temperature measurement is mainly configured, including distance, emissivity, temperature measurement range, temperature show and temperature correction settings., etc.

4.2.5.1 parameter setting

Click the "parameter setting" interface, as shown in Figure 4-24.

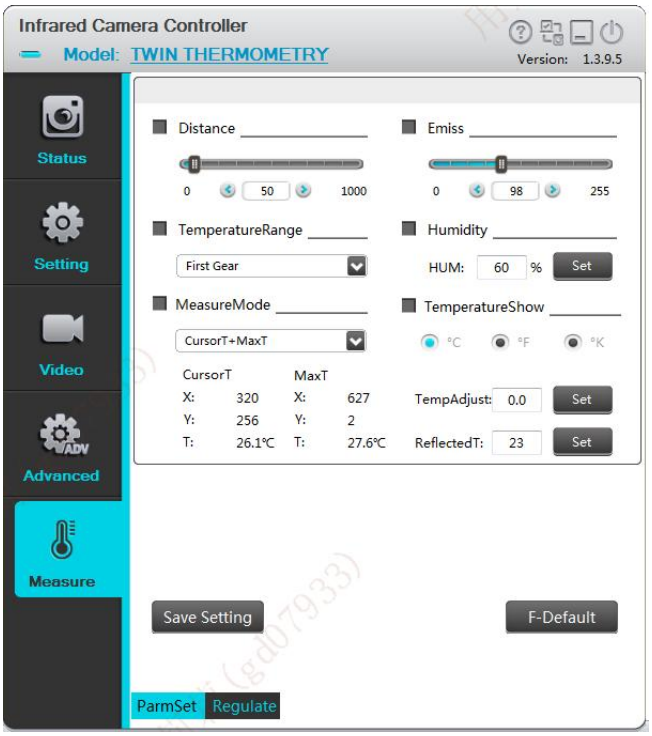
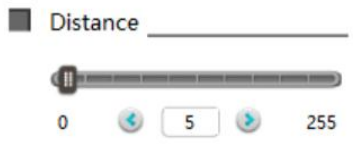


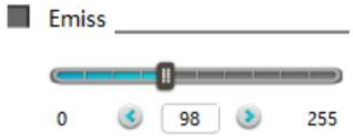
Figure 4-24 Thermography interface

Thermography interface mainly includes distance, emissivity, temperature measurement range, humidity, restore factory value, and save Settings.

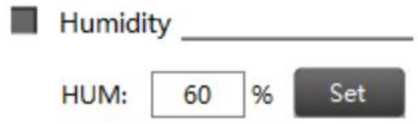
Distance ：Customizable is available, the typical distance is 5M.



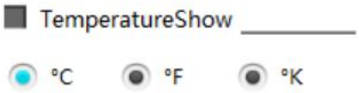
Emissivity：customizable from 0 to 100, typical radiation rate is 98 (effective value is 0.98)



Humidity: customizable from 0~100%, the typical data is 80%.

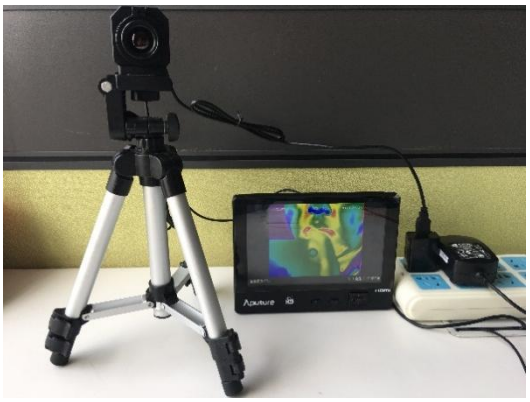


Temperature Show：the degree Celsius.



5 Frequently asked questions (FAQ)

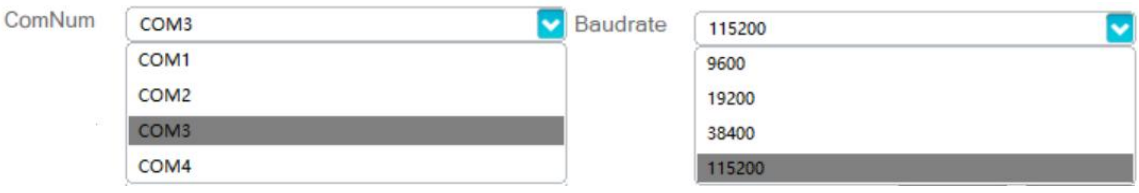
5.1 Prepare for demonstration



5.2 Frequently asked questions.

Q1:**How to choose the correct serial number to connect?**

Answer: After successful software installation, enable the device manager of the computer, and double-click "Port" to display the serial number to be connected by the module, Silicon Labs CP210x USB to UART Bridge (COM3) . Select the appropriate serial number from the connection interface for use in connection. The typical connection baud rate is 115200.



Q2: The ICC host can't work properly after installing the software and drive.

Answer:

A.Use the device manager to check whether the device drive is abnormal(usually a yellow exclamation point "!").

B. Check the expansion board model, and select the corresponding serial driver according to the expansion board model for installation.The serial port drivers corresponding to the different expansion boards are shown in the table below.

expansion board model	driver file name	remarks
usb3.0	the usb3.0 driver installation package	
usb2.0	the usb2.0 driver installation package	
VPC	the cp2102 driver	

Q3: The icc can be connected normally, but the hardware device cannot be turned on.

Answer: The customer needs to check if the computer has a built-in camera and if available, it needs to disable.

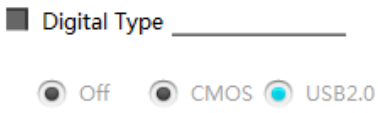
Q4: The data changes greatly and the temperature measurement is not accurate when the shutter is opened.

Answer: Temperature is a slowly varying physical quantity, and temperature is not measured too frequently. And you need to drop the abnormal frame when opening the shutter. Shutter status can be obtained by uploading the module message (excluding the frame header, the 27th word) [here one word is 2 bytes].

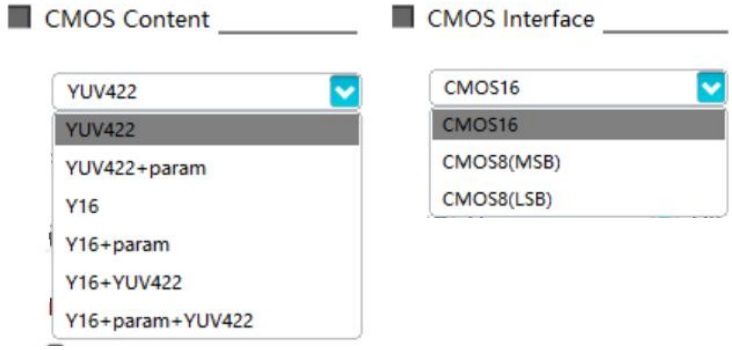
Q5: How to use digital port format?

Answer:

A. There are two kinds of digital video format can be chosen, CMOS or USB2.0



B. If you select the CMOS format, you need to select additional CMOS content and CMOS interface type to use normally.



Q6: How to obtain the usb2.0 data under the linux system?

Answer: customers need to configure the libusb in their own system.

Q7: Why can't I get an image using the demo in the SDK?

Answer: Please use the icc upper computer to view the cmos content, and align with the SDK Demo settings.

Q8: How does the Non-refrigeration module obtain the temperature of all the points?

Answer: Use SDK to obtain the grayscale data, and then call the formula interface packaged in SDK to convert the grayscale into temperature (CMOS content setting needs parameter mode, such as Y16 parameter line, Y16 parameter line YUV, etc.).

5.3 Emissivity of common materials

Material	Emissivity	Material	Emissivity
Brass mirror	0.03	Bright paint(All colour)	0.90
Polished aluminum or aluminum foil	0.09	Stone	0.92
Pebble	0.28~0.04	Concrete	0.94
Gold-plated copper	0.30	Dark paint	0.95
Solder coated copper	0.35	Water	0.95~0.96
Wood	0.78	Smooth black paint	0.96~0.98
Paper	0.80~0.95	Bark	0.98
Bitumen	0.85	Ice	0.98
Sheet metal	0.88~0.90	Skin	0.98

6 Specification of Serial Communication Protocol

6.1 Overview

This chapter describes the applicable scope and format of serial protocol of TWIN module.

1. Serial port (typical baud rate of 115200) is applied to realize the control and communication of host computer of IR module.

2. Detailed protocol contents are defined.

3. The format of basic frame is as shown in Table 6-1.

Table 6-1 Serial port data format

<table>
<tr><td colspan="2">Frame header</td><td colspan="3">To start the communication frame, two bytes, specified data [55] [AA].</td></tr>
<tr><td colspan="2">Data length</td><td colspan="3">Total number of bytes (including command word and data) of all command segments of the whole command frame, one byte;</td></tr>
<tr><td rowspan="6">Command segment</td><td>Functional classification</td><td colspan="3">Attribute of current menu.</td></tr>
<tr><td>Page</td><td colspan="3">Page number of the current menu attribute.</td></tr>
<tr><td rowspan="4">Option</td><td colspan="3">Option in current page, one byte; the highest order bit is used for marking the read-write.</td></tr>
<tr><td>bit[7]</td><td>bit[6:0]</td><td>Function</td></tr>
<tr><td rowspan="2">1(RD)</td><td>80</td><td>Query current page</td></tr>
<tr><td>xx</td><td>Read a register</td></tr>
<tr><td>0(WR)</td><td>xx</td><td>Write a register</td></tr>
<tr><td>Command word</td><td colspan="3">Value of the register, four bytes (32 bits)</td></tr>
<tr><td colspan="2">XOR checkout</td><td colspan="3">The XOR checkout words of data length byte and all bytes of command segments;</td></tr>
<tr><td colspan="2">Frame end</td><td colspan="3">To end the communication frame, one byte, specified data [F0]</td></tr>
</table>

6.2 Module connection protocol

If the software is started for the first time, select the COM port and baud rate and click CONNECT connection. The host sends a connection command, and the slave gives a response to the received query command after receiving the connection command. After receiving the response command, the host analyzes and displays the connection.

The working process as shown in Fig. 6-1.

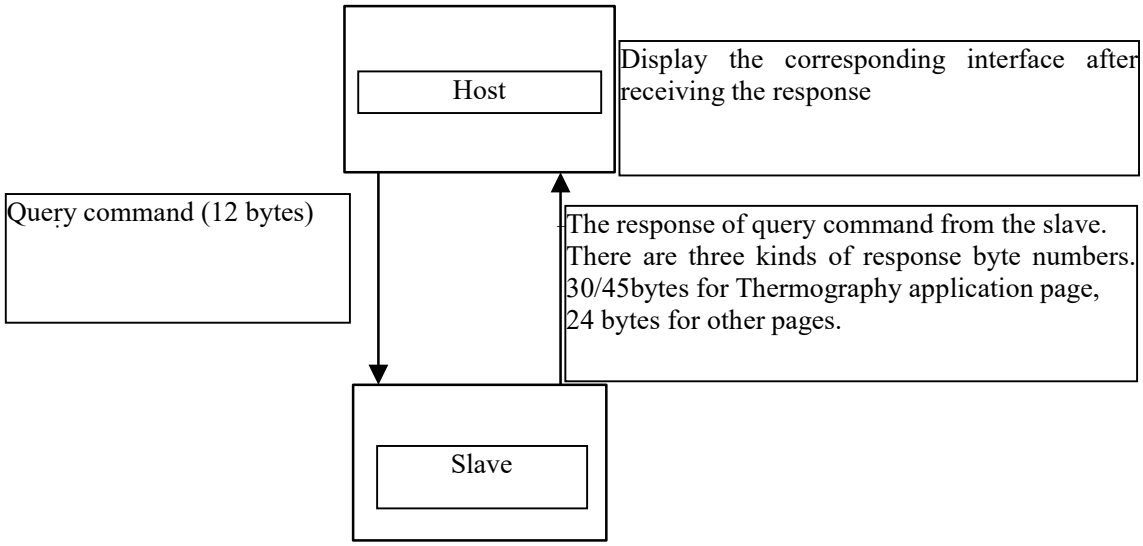


Fig. 6-1 The working process

6.2.1 Downlink protocol

There is only one type of command format of host computer, as shown in Table 5-2.

Table. 6-2 type of command format of host computer

Frame header	Length	Effective command words				Check bit	Frame end
		Functional category	Page	Option	Command word		
2 bytes	1 byte	1 byte	1 byte	1 byte	4 bytes	1 byte	1 byte
00-01	02	03	04	05	06~09	0A	0B
55 AA	07	00	00	0x/8x	00	XX	F0

The option part has 1 byte and the highest bit is used to identify the read-write operation.

The highest bit 1 represents read operation of host computer;

The highest bit 0 represents write operation of host computer;

The option of individual register begins with 0x01.

eg：

Query command: 55 AA + 07 + 00 + 00 + 80 + xxxxxxxx + XX + F0

It is used to inquire the register status of option 1 on the page 00 with function 00, in which, the command word part is invalid and any fixed value can be used.

The format of return command is same as that of query command. Place the query result 0x01020304 in the command word part, such as:

Query feedback command: 55 AA + 13+ 00 + 00 + xx…… + XX + F0

Write operation command: 55 AA + 07 + 00 + 00 + 01 + 01020304 + XX + F0

It is used to write 0x01020304 into the register of option 1 on the page 00 with function 00.

6.2.1.1 Control command

The control command format is as shown in Table 6-3.

Table 6-3 Control command format

Command word	Byte	Parameter description	Parameter type
Byte0	0x55	Frame header byte 1	Frame header
Byte1	0xAA	Frame header byte 2	
Byte2	0x07	The length is 7	Command length
Byte3	0x00	Status page	Functional classification
	0x01	Setup page	
	0x02	Video page	
	0x03	Application page	
	0x04	Temperature measurement page	
	0xA0	/	
Byte4	0x00	Page 1	Page
	0x01	Page 2	
	0x02	Page 3	
Byte5	0x01~0x07F	Option	ID number of command word
Byte6	0x00	Command high [31:24]	Command word
Byte7	0x00	Command low [23:16]	
Byte8	0x00	Command low [15:8]	
Byte9	0x00	Command low [7:0]	
Byte10	0xXX	XOR checkout	Check bit
Byte11	0xF0	Frame end	Frame end

6. 2. 1. 1. 1 Setup page

All operation commands of the function setting page: (55 AA 07 01 00 + option + command word (4 bytes) + XOR +F0). The command contents are specified as in Table 6-4.

Table 6-4 Operation commands of setup page

Option content	Option	Command word	Operation content	Operation command
Automatic compensation time (min)	0x01	00 00 00 xx	0~100	55 AA 07 01 00 01 00 00 00 xx XOR F0
Image freezing	0x02	00 0000 00	Not freezing	55 AA 07 01 00 02 00 00 00 00 04 F0
		00 0000 01	Freezing	55 AA 07 01 00 02 00 00 00 01 05 F0
Test Screen Switching	0x03	00 00 00 00	Real image	55 AA 07 01 00 03 00 00 00 00 05 F0
		00 00 00 01	Chess pattern	55 AA 07 01 00 03 00 00 00 01 04 F0
		00 00 00 02	Row gradients pattern	55 AA 07 01 00 03 00 00 00 02 07 F0
		00 00 00 03	Column gradients pattern	55 AA 07 01 00 03 00 00 00 03 06 F0
Save settings	0x04	00 00 00 01	Setting	55 AA 07 01 00 04 00 00 00 01 03 F0
Restore to factory default	0x05	00 00 00 01	Setting	55 AA 07 01 00 05 00 00 00 01 02 F0
Module restart	0x06	/	/	Not supported
temperature calibration	0x07	00 00 00 00	off	55 AA 07 01 00 07 00 00 00 00 01 F0
		00 00 00 01	on	55 AA 07 01 00 07 00 00 00 01 00 F0
Shutter control option	0x08	/	/	Not supported
Shutter manual control command	0x08	00 00 00 00	Shutter close	55 AA 07 A0 02 08 00 00 00 00 AD F0
		00 00 00 01	Shutter open	55 AA 07 A0 02 08 00 00 00 01 AC F0
Gain control (Observation type)	0x09	00 00 00 00	Standard	55 AA 07 01 00 09 00 00 00 00 0F F0
		00 00 00 01	Low noise	55 AA 07 01 00 09 00 00 00 01 0E F0

Note:

Timing compensation operation content 0 means timing compensation function is off, 1~100 means 1min~100min.

6. 2. 1. 1. 2 Video page

(1) Analog Video page

All operation command formats of the analog video page: (55 AA 07 02 00 + option + command word (4 byte) + XOR + F0). See Table 6-5 for details.

Table 6-5 Operation commands of analog video page

Option content	Option	Command word	Operation content	Operation command
Analog video switch	0x01	00 00 00 00	Off	55 AA 07 02 00 01 00 00 00 00 04 F0
		00 00 00 01	On	55 AA 07 02 00 01 00 00 00 01 05 F0
Video system switching	0x02	00 00 00 00	P:768x576	/ (This function is not supported)
		00 00 00 01	N:640x480	/ (This function is not supported)
		00 00 00 02	P:720x576	55 AA 07 02 00 02 00 00 00 02 05 F0
		00 00 00 03	N:720x480	55 AA 07 02 00 02 00 00 00 03 04 F0
Frame rate setting P-system：50/25/9 N-system：60/30/9	0x03	00 00 00 00	50/60Hz	55 AA 07 02 00 03 00 00 00 00 06 F0
		00 00 00 01	25/30Hz	55 AA 07 02 00 03 00 00 00 01 07 F0
		00 00 00 02	9Hz	55 AA 07 02 00 03 00 00 00 02 04 F0
Pseudo-color	0x04	00 00 00 00	White hot	55 AA 07 02 00 04 00 00 00 00 XOR F0
		00 00 00 01	Fulgurite	55 AA 07 02 00 04 00 00 00 01 XOR F0
		00 00 00 02	Iron Red	55 AA 07 02 00 04 00 00 00 02 XOR F0
		00 00 00 03	Hot Iron	55 AA 07 02 00 04 00 00 00 03 XOR F0
		00 00 00 04	Medical	55 AA 07 02 00 04 00 00 00 04 XOR F0
		00 00 00 05	Arctic	55 AA 07 02 00 04 00 00 00 05 XOR F0
		00 00 00 06	Rainbow 1	55 AA 07 02 00 04 00 00 00 06 XOR F0
		00 00 00 07	Rainbow 2	55 AA 07 02 00 04 00 00 00 07 XOR F0
		00 00 00 08	Tint	55 AA 07 02 00 04 00 00 00 08 XOR F0
		00 00 00 09	Black hot	55 AA 07 02 00 04 00 00 00 09 XOR F0
Mirror image	0x05	00 00 00 00	N/A	55 AA 07 02 00 05 00 00 00 00 00 F0
		00 00 00 01	Mirror X	55 AA 07 02 00 05 00 00 00 01 01 F0
		00 00 00 02	Mirror Y	55 AA 07 02 00 05 00 00 00 02 02 F0
		00 00 00 03	Mirror XY	55 AA 07 02 00 05 00 00 00 03 03 F0
EZOOM	0x06	00 00 00 xx	8~64(the effective value range 1 to 8)	55 AA 07 02 00 06 00 00 00 xx XOR F0
Coordinate X of	0x07	00 00	0~width-1	55 AA 07 02 00 07 00 00 xx xx XOR F0

Option content	Option	Command word	Operation content	Operation command
the center of zoomed area		xxxx(MSB)		
Coordinate Y of the center of zoomed area	0x08	00 00 xxxx(MSB)	0~height-1	55 AA 07 02 00 08 00 00 xx xx XOR F0
Hotspot track switch	0x09	/	/	This page is not supported

Note:

EZOOM magnification of the operation content N need to be a multiple of 8, the actual effective value is N/8 times.

(2) Digital Video page

All operation command formats of the digital video page: (55 AA 07 02 01 + option + command word (4 byte) + XOR + F0) See Table 6-6 for details.

Table 6-6 Operation commands of digital video page

Option content	Option	Command word	Operation content	Operation command
External synchronization switch	0x01	00 00 00 00	Slave mode-Off	55 AA 07 02 01 01 00 00 00 00 05 F0
		00 00 00 01	Slave mode-On	55 AA 07 02 01 01 00 00 00 01 04 F0
		00 00 00 02	Master mode	55 AA 07 02 01 01 00 00 00 02 07 F0
Digital port type	0x02	00 00 00 00	Off	55 AA 07 02 01 02 00 00 00 00 06 F0
		00 00 00 01	USB2.0	55 AA 07 02 01 02 00 00 00 01 07 F0
		00 00 00 02	CMOS	55 AA 07 02 01 02 00 00 00 02 04 F0
CMOS content selection	0x03	00 00 00 00	YUV422	55 AA 07 02 01 03 00 00 00 00 07 F0
		00 00 00 01	YUV422_ parameter line	55 AA 07 02 01 03 00 00 00 01 06 F0
		00 00 00 02	YUV16	55 AA 07 02 01 03 00 00 00 02 05 F0
		00 00 00 03	YUV16_ parameter line	55 AA 07 02 01 03 00 00 00 03 04 F0
		00 00 00 04	Y16_YUV422	55 AA 07 02 01 03 00 00 00 04 03 F0
		00 00 00 05	Y16_parameter line_ YUV422	55 AA 07 02 01 03 00 00 00 05 02 F0

Option content	Option	Command word	Operation content	Operation command
CMOS interface type	0x04	00 00 00 00	CMOS16	55 AA 07 02 01 04 00 00 00 00 00 F0
		00 00 00 01	CMOS8 (MSB first)	55 AA 07 02 01 04 00 00 00 01 01 F0
		00 00 00 02	CMOS8 (LSB first)	55 AA 07 02 01 04 00 00 00 02 02 F0
Frame rate setting P-system 50/25/9 N-system 60/30/9	0x05	00 00 00 00	50/60Hz	55 AA 07 02 01 05 00 00 00 00 01 F0
		00 00 00 01	25/30Hz	55 AA 07 02 01 05 00 00 00 01 00 F0
		00 00 00 02	9Hz	55 AA 07 02 01 05 00 00 00 02 03 F0
LVDS switch	0x06	00 00 00 00	Off	55 AA 07 02 01 06 00 00 00 00 02 F0
		00 00 00 01	On	55 AA 07 02 01 06 00 00 00 01 03 F0
Scene compensation	0x07	00 00 00 01	Compensation	55 AA 07 02 01 07 00 00 00 01 02 F0
Shutter compensation	0x08	00 00 00 01	Compensation	55 AA 07 02 01 08 00 00 00 01 0D F0
Digital port output clock phase	0x09	00 00 00 00	Rising edge alignment	55 AA 07 02 01 09 00 00 00 00 0D F0
		00 00 00 01	Fall edge alignment	55 AA 07 02 01 09 00 00 00 01 0C F0

(3) Algorithm setting page

All operation command formats of the algorithm setting page:

(55 AA 07 02 02 + option + command word (4 byte) + XOR+ F0).

See Table 6-7 for details.

Table 6-7 Operation commands of algorithm setting page

Option content	Option	Command word	Operation content	Operation command
Anti striation switch	0x05	00 00 00 00	Off	55 AA 07 02 02 05 00 00 00 00 02 F0
		00 00 00 01	On	55 AA 07 02 02 05 00 00 00 01 03 F0
Image mode(sharpening intensity)	0x06	00 00 00 00	Soft mode	55 AA 07 02 02 06 00 00 00 00 01 F0
		00 00 00 01	Standard mode	55 AA 07 02 02 06 00 00 00 01 00 F0
		00 00 00 02	Enhancement mode	55 AA 07 02 02 06 00 00 00 02 03 F0
Brightness	0x0a	00 00 00 xx	0~16	55 AA 07 02 02 0a 00 00 00 xx XOR F0

Option content	Option	Command word	Operation content	Operation command
Contrast	0x0b	00 00 00 xx	0~255	55 AA 07 02 02 0b 00 00 00 xx XOR F0
Enhanced detail gain	0x12	00 00 00 xx	0~255	55 AA 07 02 02 12 00 00 00 xx XOR F0
Dimming mode	0x18	00 00 00 00	0	55 AA 07 02 02 18 00 00 00 00 1F F0
		00 00 00 01	1	55 AA 07 02 02 18 00 00 00 01 1E F0
		00 00 00 02	2	55 AA 07 02 02 18 00 00 00 02 1D F0
Image hue	0x19	00 00 00 00	warm	55 AA 07 02 02 19 00 00 00 00 1E F0
		00 00 00 01	cool	55 AA 07 02 02 19 00 00 00 01 1F F0
Image observation mode	0x20	00 00 00 00	Observation mode	55 AA 07 02 02 20 00 00 00 00 26 F0
		00 00 00 01	Temperature measurement mode	55 AA 07 02 02 20 00 00 00 01 27 F0

6. 2. 1. 1. 3 Advanced application page

1）Focusing page

Unavailable for the module.

2）Defective pixel page

All operation command formats of the defective pixel page: (55 AA 07 03 01 + option + command word (4 byte) + XOR + F0). See Table 6-8 for details.

Table 6-8 Operation commands of defective pixel page

Option content	Option	Command word	Operation content	Operation command
Cursor coordinate X	0x02	00 00 xxxx	0~width-1	55 AA 07 03 01 02 00 00 xx xx XOR F0
Cursor coordinate Y	0x03	00 00 xxxx	0~height-1	55 AA 07 03 01 03 00 00 xx xx XOR F0
Defective pixel addition	0x04	00 00 00 01	Defective pixel addition	55 AA 07 03 01 04 00 00 00 01 00 F0
		00 00 00 03	Defective column	55 AA 07 03 01 04 00 00 00 02 03 F0

			addition	
Defective pixel saving	0x05	00 00 00 01	Setting	55 AA 07 03 01 05 00 00 00 01 01 F0

3）Menu function page

Unavailable for the module.

4）Hots tracking page 1 (region analysis)

All operation command formats of the menu page: (55 AA 07 03 03 + option + command word (4 byte) + XOR+ F0). See Table 6-9 for details.

Table 6-9 Operation commands of menu function page

Option content	Option	Command word	Operation content	Operation command
Anaysis Mode	0x01	00 00 00 00	Anaysis Off	55 AA 07 03 03 01 00 00 00 00 06 F0
		00 00 00 01	Full screen anaysis	55 AA 07 03 03 01 00 00 00 01 07 F0
		00 00 00 02	Region 1	55 AA 07 03 03 01 00 00 00 02 04 F0
		00 00 00 03	Region 2	55 AA 07 03 03 01 00 00 00 03 05 F0
		00 00 00 04	Region 3	55 AA 07 03 03 01 00 00 00 04 02 F0
Region upper left corner coordinate X	0x02	00 00 xx xx	Region analysis (0~639)	55 AA 07 03 03 02 00 00 xx xx XOR F0
Region upper left corner coordinate Y	0x03	00 00 xx xx	Region analysis (0~511)	55 AA 07 03 03 03 00 00 xx xx XOR F0
Region width W	0x04	00 00 xx xx	Region analysis 1~640	55 AA 07 03 03 04 00 00 xx xx XOR F0
Region height H	0x05	00 00 xx xx	Region analysis 1~512	55 AA 07 03 03 05 00 00 xx xx XOR F0

Note:

①Observation type setting range 0 to 65535,Thermography type setting range -50.0℃ to 1000.0℃, magnify 10 times transmission.

5) Hotspot tracking page 3

Pseudo-color vision enhancement all operation commands: 55 AA 07 03 05 + option + command word (4 byte) +XOR + F0.

Fig.6-10 isotherm operation commands

Option content	Option	Command word	Operation content	Operation command
Isotherm switch （isotherm）	0x06	00 00 00 00	Off	55 AA 07 03 05 06 00 00 00 00 07 F0
		00 00 00 01	On	55 AA 07 03 05 06 00 00 00 01 06 F0
Upper limit of isotherm threshold	0x08	00 00 xx xx	Note①	55 AA 07 03 05 08 00 00 xx xx XOR F0
Lower limit of isotherm threshold	0x09	00 00 xx xx		55 AA 07 03 05 09 00 00 xx xx XOR F0
Isothermal pseudo-color band selection	0x0d	00 00 00 00	White heat	55 AA 07 03 05 0d 00 00 00 00 0C F0
		00 00 00 01	fulgurite	55 AA 07 03 05 0d 00 00 00 01 0D F0
		00 00 00 02	iron red	55 AA 07 03 05 0d 00 00 00 02 0E F0
		00 00 00 03	hot iron	55 AA 07 03 05 0d 00 00 00 03 0F F0
		00 00 00 04	medical treatment	55 AA 07 03 05 0d 00 00 00 04 08 F0
		00 00 00 05	arctic	55 AA 07 03 05 0d 00 00 00 05 09 F0
		00 00 00 06	Rainbow 1	55 AA 07 03 05 0d 00 00 00 06 0A F0
		00 00 00 07	Rainbow 2	55 AA 07 03 05 0d 00 00 00 07 0B F0
		00 00 00 08	Trace red	55 AA 07 03 05 0d 00 00 00 08 04 F0
		00 00 00 09	Black heat	55 AA 07 03 05 0d 00 00 00 09 05 F0

Note:①Thermography type setting range -50.0℃ to 1000.0℃, magnify 10 times transmission.

6. 2. 1. 1. 4 Temperature measurement page

1) Parameter setting page

All operation commands of the function parameter setting page：（55 AA 07 04 00 + option + command word (4 bytes) + XOR + F0）. The command contents are specified as shown in Table6-11.

Table 6-11 Operation commands of menu function page

Option content	Option	Command word	Operation content	Operation command
Distance setting	0x01	00 00 00 xx	0~100	55 AA 07 04 00 01 00 00 00 xx XOR F0
Emissivity setting	0x02	00 00 00 xx	0~100	55 AA 07 04 00 02 00 00 00 xx XOR F0
Measurement mode	0x03	00 00 00 00	Min + max temp.	55 AA 07 04 00 03 00 00 00 00 00 F0
		00 00 00 01	cursor spot+ max temp.	55 AA 07 04 00 03 00 00 00 01 01 F0
		00 00 00 02	min + cursor spot temp.	55 AA 07 04 00 03 00 00 00 02 02 F0
Factory reset	0x06	00 00 00 01	Setting	55 AA 07 04 00 06 00 00 00 01 04 F0
Reflected setting	0x07	00 00 xx xx	Setting	55 AA 07 04 00 07 00 00 xx xx XOR F0
Save settings	0x04	00 00 00 01	Setting	55 AA 07 01 00 04 00 00 00 01 03 F0
Humidity Save settings	0x08	00 00 00 xx	Setting	55 AA 07 04 00 08 00 00 00 xx XOR F0
Temperature measurement range	0x09	00 00 00 00	-20℃~150℃	55 AA 07 04 00 09 00 00 00 00 0A F0
		00 00 00 01	-20℃~550℃	55 AA 07 04 00 09 00 00 00 01 0B F0

2) Thermography calibration page

All operation commands of the function blackbody correction page：（55 AA 07 04 01 + option + command word (4 bytes) + XOR + F0）. See Table 6-12 for details.

Table6-12 Blackbody correction page operating command

Option content	Option	Command word	Operation content	Operation command
Low temperature blackbody collection	0x01	00 00 00 01	Collect low temperature Y16	55 AA 07 04 01 01 00 00 00 01 02 F0
High temperature blackbody collection	0x02	00 00 00 01	Collect high temperature Y16	55 AA 07 04 02 02 00 00 00 01 01 F0
Two point collection	0x03	00 00 00 01	Start correction	55 AA 07 04 01 03 00 00 00 01 00 F0
Single point blackbody acquisition	0x04	00 00 xx xx	0~8000,corresponding to 0 ℃~800℃	55 AA 07 04 01 04 00 00 00 xx XOR F0
Single point collection	0x05	00 00 00 01	Start correction	55 AA 07 04 01 05 00 00 00 01 06 F0

Save options	0x04	00 00 00 01	Setting	55 AA 07 01 00 04 00 00 00 01 03 F0
Low temperature blackbody setting	0x06	00 00 XX XX	-400~8000, corresponding to -40℃~800℃	55 AA 07 04 01 06 00 00 xx xx XOR F0
High temperature blackbody setting temperature switch	0x07	00 00 XX XX		55 AA 07 04 01 07 00 00 xx xx XOR F0
Single point blackbody setting	0x08	00 00 xxxx		55 AA 07 04 01 08 00 00 xx xx XOR F0
Cancel setting	0x09	00 00 00 01		55 AA 07 04 01 09 00 00 00 01 0A F0

6.2.1.2 Query command

The query commands are as shown in Table 6-13.

Table 6-13 Query commands

Command word	Byte	Parameter description	Parameter type
Byte0	0x55	Frame header byte 1	Frame header
Byte1	0xAA	Frame header byte 2	
Byte2	0x07	Length is 7	Command length
Byte3	0x00	Status page	Functional classification
	0x01	Setup page	
	0x02	Video page	
	0x03	Application page	
	0x04	Measurement page	
Byte4	0x00	Page 1	Page
	0x01	Page 2	
	0x02	Page 3	
Byte5	0x80	Page query code	
Byte6	0x00	0x00	Command word (command word is invalid at query, and the default is 0x00)
Byte7	0x00	0x00	
Byte8	0x00	0x00	
Byte9	0x00	0x00	
Byte10	0xXX	XOR checkout	Check bit

Byte11	0xF0	Frame end	Frame end

6.2.2 Uplink protocol

6.2.2.1 Handshake return

If the slave computer requires a certain time in responding to the control of host computer, the slave computer will return the operation completion command upon its completion of response operation, so that the host computer can continue operation. If no return command is received within the agreed time, the prompt of operation failed will be displayed.

The return command format is as shown in Table 6-14.

Table 6-14 Return command format

Frame header	Length	Option	Checksum	Frame end
2 bytes	1 byte	1 byte	1 byte	1 byte
00-01	02	03	04	05
55 AA	01	xx	XX	F0

1. Confirm the command receiving: 55 AA 01 00 01 F0.

2. Receiving error, resending of command is requested: 55 AA 01 01 00 F0.

See Table 6-15 for details of return command.

Table 6-15 Return commands

Command word	Byte	Parameter description	Parameter type
Byte0	0x55	Frame header byte 1	Frame header
Byte1	0xAA	Frame header byte 2	
Byte2	0x01	Length is 1	Command length
Byte3	0x00	Receiving confirmation	Receiving confirmation
	0x01	Receiving error, resending of command is requested	Receiving error, resending of command is requested
	0x02	Save settings	Return to current option number upon the completion of response
	0x03	Restore factory settings	
	0x04	Restart	
	0x05	Scene compensation	
	0x06	Shutter compensation	
	0x13	BL compensation	
	0x14	BH compensation	
	0x15	Calculate K	
	0x16	Save K	
	0x17	Load K	

Command word	Byte	Parameter description	Parameter type
	0x18	Load initial K	
	0x25	Upload BL	
	0x26	Upload BH	
	0x28	Upload NUC	
	0x29	Temperature parameter restored to factory default successfully	
	0x1A	Upload B0	
	0x1B	Upload B1	
	0x1C	Upload B2	
	0x1D	Upload B3	
	0x1E	Upload B4	
Byte3	0x1F	Upload B5	Return to current option number upon the completion of response
	0x20	Upload B6	
	0x21	Upload B7	
	0x22	Upload B8	
	0x23	Upload B9	
	0x24	Upload K	
	0x25	Upload BL	
	0x26	Upload BH	
	0x27	Upload NUC	
	0x50	Upload PROGRAM	
	0x51	Upload FILTER	
	0x52	Upload RMS	
	0x53	Upload IDE	
	0x54	Upload IMAGE_RGB	
	0x55	Upload SINGLE_TMP	
	0x56	Upload START_IMAGE_RGB	
	0x57	Upload START_IMAGE	
	0x58	Upload MENU_RGB	
	0x59	Upload MENU	

Command word	Byte	Parameter description	Parameter type
	0x5A	Upload LOG	
	0x5B	Upload HF_CURSOR	
	0x5C	Upload ZSP_PROGRAM	
	0x34	Program upgrading	
	0x39	Defective pixel saving	
	0x40	Defective pixel addition	
	0x47	Low temperature blackbody collection completed	
	0x41	High temperature blackbody collection completed	
	0x42	Two point calibration successful	
	0x43	Two point calibration failed	
Byte3	0x44	Single point collection completed	Return to current option number upon the completion of response
	0x45	Single point calibration successful	
	0x46	Single point calibration failed	
	0xA0	The “start to upload” mark of asic	
	0xA1	The “upgrading failed” mark of asic	
	0xA2	asic starts to flash	
Byte4	0xXX	XOR checkout	Check bit
Byte5	0xF0	Frame end	Frame end

6.2.2.2 Query return

After receiving the query command, the slave computer will respond and return all information of the queried page to the host computer. The response command format of lower computer is consistent with the return command format at query. Query returns are generally 24 bytes, and the thermography application page has special 30, 45 bytes.

The format of 24\30\45 bytes query return commands are as shown in Table6-16、6-17、6-18.

Table 6-16 Format of 24-bytes query return command

Frame header	Length	Valid command word			Check bit	Frame end
		Functional classification	Page	Option		
2Byte	1Byte	1Byte	1Byte	17Byte	1Byte	1Byte

00-01		02	03	04	05~21	22	23
55	AA	13	00	00	0000000…	XX	55

Table 6-17 Format of 30-bytes query return command

Frame header		Length	Valid command word			Check bit	Frame end
			Functional classification	Page	Option		
2Byte		1Byte	1Byte	1Byte	23Byte	1Byte	1Byte
00-01		02	03	04	05~27	28	29
55	AA	19	00	00	00 00000…	XX	F0

Table 6-18 Format of 45-bytes query return command

Frame header		Length	Valid command word			Frame header	Length
			Functional classification	Page	Option		
2Byte		1Byte	1Byte	1Byte	38Byte	1Byte	1Byte
00-01		02	03	04	05~42	43	44
55	AA	28	00	00	00 00000…	XX	F0

Details of 24\30\45 bytes query response command of salve computer are described in Table 6-19, 6-20, 6-21.

Table 6-19 24-bytes query return command

Command word	Byte	Parameter description	Parameter type
Byte0	0x55	Frame header byte 1	Frame header
Byte1	0xAA	Frame header byte 2	
Byte2	0x13	Length is 19	Command length
Byte3	0x00	Status page	Functional classification
	0x01	Setup page	
	0x02	Video page	
	0x03	Advance setting page	
	0x04	Measurement page	
Byte4	0x00	Page 1	
	0x01	Page 2	
	0x01	Page 3	
Byte5	0x00	Command of option 1	
Byte6	0x00	Command of option 2	
Byte7	0x00	Command of option 3	
Byte8	0x00	Command of option 4	
Byte9	0x00	Command of option 5	

Command word	Byte	Parameter description	Parameter type
Byte10	0x00	Command of option 6	
Byte11	0x00	Command of option 7	
Byte12	0x00	Command of option 8	
Byte13	0x00	Command of option 9	
Byte14	0x00	Command of option 10	
Byte15	0x00	Command of option 11	
Byte16	0x00	Command of option 12	
Byte17	0x00	Command of option 13	
Byte18	0x00	Command of option 14	
Byte19	0x00	Command of option 15	
Byte20	0x00	Command of option 16	
Byte21	0x00	Command of option 17	
Byte22	0xXX	XOR checkout	Check bit
Byte23	0xF0	Frame end	Frame end

Table6-20 30-bytes query return command

Command word	Byte	Parameter description	Parameter type
Byte0	0x55	Frame header byte 1	Frame header
Byte1	0xAA	Frame header byte 2	
Byte2	0x19	Length is 25	Command length
Byte3	0x00	Status page	Functional classification
	0x01	Setup page	
	0x02	Video page	
	0x03	Advance setting page	
	0x04	Measurement page	
Byte4	0x00	Page 1	Page
	0x01	Page 2	
	0x01	Page 3	
Byte5	0x00	Command of option 1	Command word

Command word	Byte	Parameter description	Parameter type
Byte6	0x00	Command of option 2	
Byte7	0x00	Command of option 3	
Byte8	0x00	Command of option 4	
Byte9	0x00	Command of option 5	
Byte10	0x00	Command of option 6	
Byte11	0x00	Command of option 7	
Byte12	0x00	Command of option 8	
Byte13	0x00	Command of option 9	
Byte14	0x00	Command of option 10	
Byte15	0x00	Command of option 11	
Byte16	0x00	Command of option 12	
Byte17	0x00	Command of option 13	
Byte18	0x00	Command of option 14	
Byte19	0x00	Command of option 15	
Byte20	0x00	Command of option 16	
Byte21	0x00	Command of option 17	
Byte22	0x00	Command of option 18	
Byte23	0x00	Command of option 19	
Byte24	0x00	Command of option 20	
Byte25	0x00	Command of option 21	
Byte26	0x00	Command of option 22	
Byte27	0x00	Command of option 23	
Byte28	0xXX	XOR checkout	Check bit
Byte29	0xF0	Frame end	Frame end

Table6-21 45-bytes query return command

Command word	Byte	Parameter description	Parameter type
Byte0	0x55	Frame header byte 1	Frame header
Byte1	0xAA	Frame header byte 2	

Command word	Byte	Parameter description	Parameter type
Byte2	0x28	Length is 40	Command length
Byte3	0x00	Status page	Functional classification
	0x01	Setup page	
	0x02	Video page	
	0x03	Advance setting page	
	0x04	Measurement page	
Byte4	0x00	Page 1	Page
	0x01	Page 2	
	0x02	Page 3	
Byte5	0x00	Command of option 1	Command word
Byte6	0x00	Command of option 2	
Byte7	0x00	Command of option 3	Command word
Byte8	0x00	Command of option 4	
Byte9	0x00	Command of option 5	
Byte10	0x00	Command of option 6	
Byte11	0x00	Command of option 7	
Byte12	0x00	Command of option 8	
Byte13	0x00	Command of option 9	
Byte14	0x00	Command of option 10	
Byte15	0x00	Command of option 11	
Byte16	0x00	Command of option 12	
Byte17	0x00	Command of option 13	
Byte18	0x00	Command of option 14	
Byte19	0x00	Command of option 15	
Byte20	0x00	Command of option 16	
Byte21	0x00	Command of option 17	
Byte22	0x00	Command of option 18	
Byte23	0x00	Command of option 19	

Command word	Byte	Parameter description	Parameter type
Byte24	0x00	Command of option 20	
Byte25	0x00	Command of option 21	
Byte26	0x00	Command of option 22	
Byte27	0x00	Command of option 23	
Byte28	0x00	Command of option 24	
Byte29	0x00	Command of option 25	
Byte30	0x00	Command of option 26	
Byte31	0x00	Command of option 27	
Byte32	0x00	Command of option 28	
Byte33	0x00	Command of option 29	
Byte34	0x00	Command of option 30	
Byte35	0x00	Command of option 31	Command word
Byte36	0x00	Command of option 32	
Byte37	0x00	Command of option 33	
Byte38	0x00	Command of option 34	
Byte39	0x00	Command of option 35	
Byte40	0x00	Command of option 36	
Byte41	0x00	Command of option 37	
Byte42	0x00	Command of option 38	
Byte43	0xXX	XOR checkout	Check bit
Byte44	0xF0	Frame end	Frame end

6. 2. 2. 2. 1 Status page

Query command: 55 AA 07 00 00 80 00 00 00 00 87 F0.

Query response command contents of the status page are as shown in Table 6-22.

Table 6-22 Commands of status page

Command word	Byte	Parameter description	Parameter type
Byte0	0x55	Frame header byte 1	Frame header

Command word	Byte	Parameter description	Parameter type
Byte1	0xAA	Frame header byte 2	
Byte2	0x13	Length is 19	Command length
Byte3	0x00	Status page	Functional classification
Byte4	0x00	Page 1	Page number
Byte5	0x0A	TWIN612 Obervation type	ID number of module
	0x0B	TWIN612 Thermography type	
	Others	Reserved	
Byte6	0x00		ID number of communication object
Byte7	0x0D	Year (13)	Program version
Byte8	0x06	Month (06)	
Byte9	0x16	Day (22)	
Byte10	0x1E	Focal spot temperature high 8 bit	Focal plane temperature (precision: 0.01)
Byte11	0x00	Focal spot temperature low 8 bit	
Byte12	0x00	Video system	Video system
Byte13	0x08	640×512	ID number of resolution
	Others	Reserved	
Byte14	xx	Machine identification code [31:24]	
Byte15	xx	Machine identification code [23:16]	
Byte16	xx	Machine identification code[15:8]	
Byte17	xx	Machine identification code [7:0]	
Byte18~Byte21	0x00	Reserved	
Byte22	0xXX	Checksum	Check bit
Byte23	0xF0	Frame end	Frame end

6. 2. 2. 2. 2 Setup page

Query command: 55 AA 07 01 00 80 00 00 00 00 86 F0.

Query response command contents of the setup page are as shown in Table 6-23.

Table 6-23 Commands of setup page

Command word	Byte	Parameter description	Parameter type
Byte0	0x55	Frame header byte 1	Frame header
Byte1	0xAA	Frame header byte 2	
Byte2	0x13	Length is 19	Command length
Byte3	0x01	SETUP Status page	Functional classification
Byte4	0x00	Page 1	Page
Byte5	xx	Automatic compensation time (xxmin)	Command of option 1
Byte6	0x00	Image not freezing	Command of option 2
	0x01	Image freezing	
Byte7	0x00	Real-time image	Command of option 3
	0x01	Checker board pattern	
	0x02	Row gradients	
	0x03	Line gradients	
Byte8	0x00	The rising of temperature calibration switch off	
	0x01	The rising of temperature calibration switch on	
Byte9	0x00	Shutter control mode	Not supported
Byte10	0x00	Shutter close off	
	0x01	Shutter close on	
Byte11	0x00	Standard mode	Observation type
	0x01	Low noise mode	
Byte12~ Byte21	0x00	Reserved	
Byte22	0xXX	Checksum	Check bit
Byte23	0xF0	Frame end	Frame end

6. 2. 2. 2. 3 Video page

Analog video page

Query response command contents of the analog video page are as shown in Table 6-24.

Table 6-24 Commands of analog video page

Command word	Byte	Parameter description	Parameter type
Byte0	0x55	Frame header byte 1	Frame header
Byte1	0xAA	Frame header byte 2	
Byte2	0x13	Length is 19	Command length
Byte3	0x02	Video page	Functional classification
Byte4	0x00	Analog video page (Page 1)	Page
Byte5	0x00	Analog video off	
	0x01	Analog video on	
Byte6	0x00	/	
	0x01	/	
	0x02	P-system 720x576	
	0x03	N-system 720x480	
Byte7 P-system 50/25/9 N-system 60/30/9	0x00	50/60Hz	
	0x01	25/30Hz	
	0x02	9Hz	
Byte8	xx	Pseudo-color	
Byte9	0x00	No	
	0x01	Mirror image in X direction	
	0x02	Mirror image in Y direction	
	0x03	Mirror images in X and Y directions	
Byte10	xx	EZOOM zoom factor 8~64	
Byte11	xx	Coordinate X [15:0] of the center of zoomed area	

Command word	Byte	Parameter description	Parameter type
Byte12	xx	Coordinate X [7:0] of the center of zoomed area	
Byte13	xx	Coordinate Y [15:0] of the center of zoomed area	
Byte14	xx	Coordinate Y [7:0] of the center of zoomed area	
Byte15	0x00	Hot track switch	unsupported
Byte16~ Byte21	0x00	Reserved	
Byte22	0xXX	Checksum	Check bit
Byte23	0xF0	Frame end	Frame end

Digital video page

Query command: 55 AA 07 02 01 80 00 00 00 00 84 F0.

Query response command contents of the digital video page are as shown in Table 6-25.

Table 6-25 Commands of digital video page

Command word	Byte	Parameter description	Parameter type
Byte0	0x55	Frame header byte 1	Frame header
Byte1	0xAA	Frame header byte 2	
Byte2	0x13	Length is 19	Command length
Byte3	0x02	Video page	Functional classification
Byte4	0x01	Digital video page (Page 2)	Page
Byte5	0x00	External synchronization enabling off	
	0x01	External synchronization enabling on	
	0x02	External synchronization main mode	
Byte6	0x00	Digital port parallel off	
	0x01	Digital port USB2.0	
	0x02	Digital port CMOS	
Byte7	0x00	YUV422	Command of option 3

Command word	Byte	Parameter description	Parameter type
	0x01	YUV422_ parameter line	Parallel output contents
	0x02	YUV16	
	0x03	YUV16_ parameter line	
	0x04	Y16_YUV422	
	0x05	Y16_parameter line_ YUV422	
Byte8	0x01	CMOS8(MSB first)	Parallel output interface type
	0x02	CMOS8(LSB first)	
Byte9	0x00	50/60Hz	Command of option 5
	0x01	25/30Hz	
	0x01	Fall edge alignment	
Byte10~ Byte21	0x00	Reserved	
Byte22	0xXX	Checksum	Check bit
Byte23	0xF0	Frame end	Frame end

Algorithm control page 1

Query command: 55 AA 07 02 04 80 00 00 00 00 81 F0.

Query response command contents of the algorithm control page 1 are as shown in Table 6-26.

Table 6-26 Algorithm control page 1

Command word	Byte	Parameter description	Parameter type
Byte0	0x55	Frame header byte 1	Frame header
Byte1	0xAA	Frame header byte 2	
Byte2	0x13	Length is 19	Command length
Byte3	0x02	Video page	Functional classification
Byte4	0x02	Digital video page (Page 5)	Page
Byte5	0x00	Ainti striation off	Option 1 command
	0x01	Ainti striation on	
Byte6	XX	Brightness adjustment 0~16	Option 2 command
Byte7	0x00	Contrast adjustment:0~255	Option 3 command

Command word	Byte	Parameter description	Parameter type
Byte8	XX	Enhanced detail gain:0~255	Option 4 command
Byte9	0x00	EE enhancement algorithm off	Option 5 command
	0x01	EE enhancement algorithm on	
Byte10	0x00	2D noise reduction 0	Option 6 command
	0x01	2D noise reduction 1	
	0x02	2D noise reduction 2	
Byte11		DRC mode 1	DRC mode
		DRC mode 2	
Byte12~ Byte21	0x00	Reserved	
Byte22	0xXX	Checksum	Check bit
Byte23	0xF0	Frame end	Frame end

6. 2. 2. 2. 4 Advanced application page

(1)Focusing page

Unavailable for the module.

(2)Defective pixel page

Query command：55 AA 07 03 01 80 00 00 00 00 85 F0.

Query response command contents of the defective pixel page are as shown in Table 6-27.

Table 6-27 Commands of defective pixel page

Command word	Byte	Parameter description	Parameter type
Byte0	0x55	Frame header byte 1	Frame header
Byte1	0xAA	Frame header byte 2	
Byte2	0x13	Length is 19	Command length
Byte3	0x03	Application	Functional classification
Byte4	0x01	Defective pixel correction page (page 2)	Page
Byte5	xx	Reserved	

Command word	Byte	Parameter description	Parameter type
Byte6	xx	Cursor location X[15:8]	
Byte7	xx	Cursor location X[7:0]	
Byte8	xx	Cursor location Y[15:8]	
Byte9	xx	Cursor location Y[7:0]	
Byte10	xx	AD value of cursor point [15:8]	
Byte11	xx	AD value of cursor point [7:0]	
Byte12~ Byte19	xx	Reserved	
Byte20	xx	Cursor point Y16 [15:8]	
Byte21	xx	Cursor point Y16 [7:0]	
Byte22	0xXX	Checksum	Check bit
Byte23	0xF0	Frame end	Frame end

(3)Menu function page

Unavailable for the module.

(4) Hot tracking page 1 (regional analysis)
Query command：55 AA 07 03 04 80 00 00 00 00 80 F0.

Table 6-28 regional analysis page command

Command word	Bytes	Parameter specification	Parameter type
Byte0	0x55	Frame header byte 1	Frame header
Byte1	0xAA	Frame header byte 2	
Byte2	0x28	Length 40	Command length
Byte3	0x03	Application	Functional classification
Byte4	0x04	regional analysis page （The fourth page）	Page number
Byte5	0x00	Close analysis	Option 1 command
	0x01	Full screen analysis	
	0x02	Region 1	Option 1 command

Command word	Bytes	Parameter specification	Parameter type
	0x03	Region 2	
	0x04	Region 3	
Byte6	xx	Upper left corner of regional Coordinate X[15：8]	Option 2 command
Byte7	xx	Upper left corner of regional Coordinate X[7:0]	
Byte8	xx	Upper left corner of regional Coordinate Y[15：8]	Option 3 command
Byte9	xx	Upper left corner of regional Coordinate Y[7:0]	
Byte10	xx	Upper left corner of regional Coordinate W[15：8]	Option 4 command
Byte11	xx	Upper left corner of regional Coordinate W[7:0]	
Byte12	xx	Upper left corner of regional Coordinate H[15：8]	Option 5 command
Byte13	xx	Upper left corner of regional Coordinate H[7:0]	
Byte14~Byte20	xx	Reserved	
Byte21	xx	The coldest spot coordinate X[15：8]	
Byte22	xx	The coldest spot coordinate X[7:0]	
Byte23	xx	The coldest spot coordinate Y[15：8]	
Byte24	xx	The coldest spot coordinate Y[7:0]	
Byte25	xx	The coldest spot temperature/Y16[15：8]	Observation type 0-65535, Thermography type-50℃-1000℃, Magnify 10 times
Byte26	xx	The coldest spot temperature/Y16[7:0]	
Byte27	xx	The hottest spot coordinate X[15：8]	
Byte28	xx	The hottest spot coordinate X[7:0]	
Byte29	xx	The hottest spot coordinate Y[15：8]	
Byte30	xx	The hottest spot coordinate Y[7:0]	

Command word	Bytes	Parameter specification	Parameter type
Byte31	xx	The hottest spot temperature/Y16[15：8]	Observation type 0-65535, Thermography type-50℃-1000℃, Magnify 10 times
Byte32	xx	The hottest spot temperature/Y16[7:0]	
Byte33	xx	Cursor spot coordinate X[15：8]	
Byte34	xx	Cursor spot coordinate X[7:0]	
Byte35	xx	Cursor spot coordinate Y[15：8]	
Byte36	xx	Cursor spot coordinate Y[7:0]	
Byte37	xx	Cursor spot temperature/Y16[15：8]	Observation type 0-65535, Thermography type-50℃-1000℃, Magnify 10 times
Byte38	xx	Cursor spot temperature/Y16[7:0]	
Byte39	xx	Regional average temperature/Y16[15：8]	Observation type 0-65535, Thermography type-50℃-1000℃, Magnify 10 times
Byte40	xx	Regional average temperature/Y16[7:0]	
Byte41	0x00	Reserved	
Byte42	0x00	Reserved	
Byte43	0xXX	Checksum	Check bit
Byte44	0xF0	Frame end	Frame end

(5) Hotspot tracking page 3 (isotherm)

Query command：55 AA 07 03 06 80 00 00 00 00 82 F0.

Table 6-29 Isotherm page command

Command word	Bytes	Parameter specification	Parameter type
Byte0	0x55	Frame header byte 1	Frame header
Byte1	0xAA	Frame header byte 2	
Byte2	0x19	Length 25	Command length
Byte3	0x03	Application	Functional classification
Byte4	0x06	Hot tracking page （The sixth page）	Page number
Byte5~ Byte11	0x00	Reserved	
Byte12	0x00	Isotherm off	

Command word	Bytes	Parameter specification	Parameter type
	0x01	Isotherm on	
Byte13	0x00	Upper and lower isotherm display mode	
	0x01	Medium isotherm display mode	
Byte14	xx	Upper limit of isotherm threshold[15:8]	Observation type 0-65535, Thermography type-50℃ -1000℃, Magnify 10 times
Byte15	xx	Upper limit of isotherm threshold[7:0]	
Byte16	xx	Lower limit of isotherm threshold[15:8]	Observation type 0-65535, Thermography type-50℃ -1000℃, Magnify 10 times
Byte17	xx	Lower limit of isotherm threshold[7:0]	
Byte18~ Byte26	0x00	Reserved	
Byte27	0x00	White heat	
	0x01	fulgurite	
	0x02	iron red	
	0x03	hot iron	
	0x04	medical treatment	
	0x05	arctic	
	0x06	Rainbow 1	
	0x07	Rainbow 2	
	0x08	Trace red	
	0x09	Black heat	
Byte28	0xXX	Checksum	Check byte
Byte29	0xF0	Frame end	Frame end

6. 2. 2. 2. 5 Thermography page

(1) Parameter setting page

Query command: 55 AA 07 04 00 80 00 00 00 00 83 F0.

Query response command contents of the temperature measurement page are as shown in Table 6-30.

Table6-30 Thermography function page 1 command

Command word	Byte	Parameter description	Parameter type
Byte0	0x55	Frame header byte 1	Frame header
Byte1	0xAA	Frame header byte 2	
Byte2	0x19	Length is 25	Command length
Byte3	0x04	Measurement page	Functional classification

Command word	Byte	Parameter description	Parameter type
Byte4	0x00	Page 1	Page number
Byte5	0-255	The value of distance setting	
Byte6	0-255	The value of emissivity setting	
Byte7	00	Minimum + maximum temperature of current analysis object	
Byte7	01	Cross cursor spot+ maximum temperature	
	02	minimum + Cross cursor spot temperature	
Byte8	00	Temperature unit: ℃	
	01	Temperature unit: ℉	
	02	Temperature unit: °K	
Byte9	0x00	Reserved	
Byte10	0x00	Reserved	
Byte11	xx	Coordinate X [15:8] is based on byte7 value	The parameters(coordinate X, coordinate Y, temperature) of the first point are related to byte7 value: 00 means minimum temp. 01means cross cursor temp. 02 means Minimum temp. (actual temperature*10)
Byte12	xx	Coordinate X [7:0] is based on byte7 value	
Byte13	xx	Coordinate Y [15:8] is based on byte7 value	
Byte14	xx	Coordinate Y [7:0] is based on byte7 value	
Byte15	xx	The temperature[15 : 8] after calibration is based on byte7 value	
Byte16	xx	The temperature[7 : 0] after calibration is based on byte7 value	
Byte17	xx	Coordinate X [15:8] is based on byte7 value	The parameters(coordinate X, coordinate Y, temperature) of the second point are related to byte7 value : 00: Maximum temp. 01: Maximum temp. 02: Cross cursor temp.
Byte18	xx	Coordinate X [7:0] is based on byte7 value	
Byte19	xx	Coordinate Y [15:8] is based on byte7 value	
Byte20	xx	Coordinate Y [7:0] is based on byte7 value	
Byte21	xx	The temperature[15 : 8] after	

Command word	Byte	Parameter description	Parameter type
		calibration is based on setting of byte7 value	(actual temperature*10)
Byte22	xx	The temperature[7 : 0] after calibration is based on setting of byte7 value	
Byte23	xx	Reflected temp[15 : 8]	
Byte24	xx	Reflected temp [7 : 0]	
Byte25	xx	Humidity value	
Byte26	xx	Temperature measurement range	
Byte27	0x00	Reserved	
Byte28	0xXX	XOR checkout	Check bit
Byte29	0xF0	Frame end	Frame end

(2) Blackbody correction page

Query command: 55 AA 07 04 01 80 00 00 00 00 82 F0.

Query response command contents of the blackbody correction page are as shown in Table 6-31.

Table 6-31 Thermography function page 2 command

Command word	Byte	Parameter description	Parameter type
Byte0	0x55	Frame header byte 1	Frame header
Byte1	0xAA	Frame header byte 2	
Byte2	0x19	Length is 25	Command length
Byte3	0x04	Measurement page	Functional classification
Byte4	0x01	Page 2	Page number
Byte5	xx	Low blackbody temperature [15:8]	
Byte6	xx	Low blackbody temperature [7:0]	
Byte7	xx	High blackbody temperature [15:8]	
Byte8	xx	High blackbody temperature [7:0]	
Byte9	xx	Single point blackbody temperature [15:8]	
Byte10	xx	Single point blackbody temperature [7:0]	
Byte11~ Byte27		Reserved	
Byte28	0xXX	XOR checkout	Check bit
Byte29	0xF0	Frame end	Frame end

Remark:

The "highest temperature", "lowest temperature", "central temperature" and "average temperature" mentioned in the above table are "10* actual temperature".

7 Mechanical interface specification

7.1 The structure of bare TWIN612 with 13mm lens

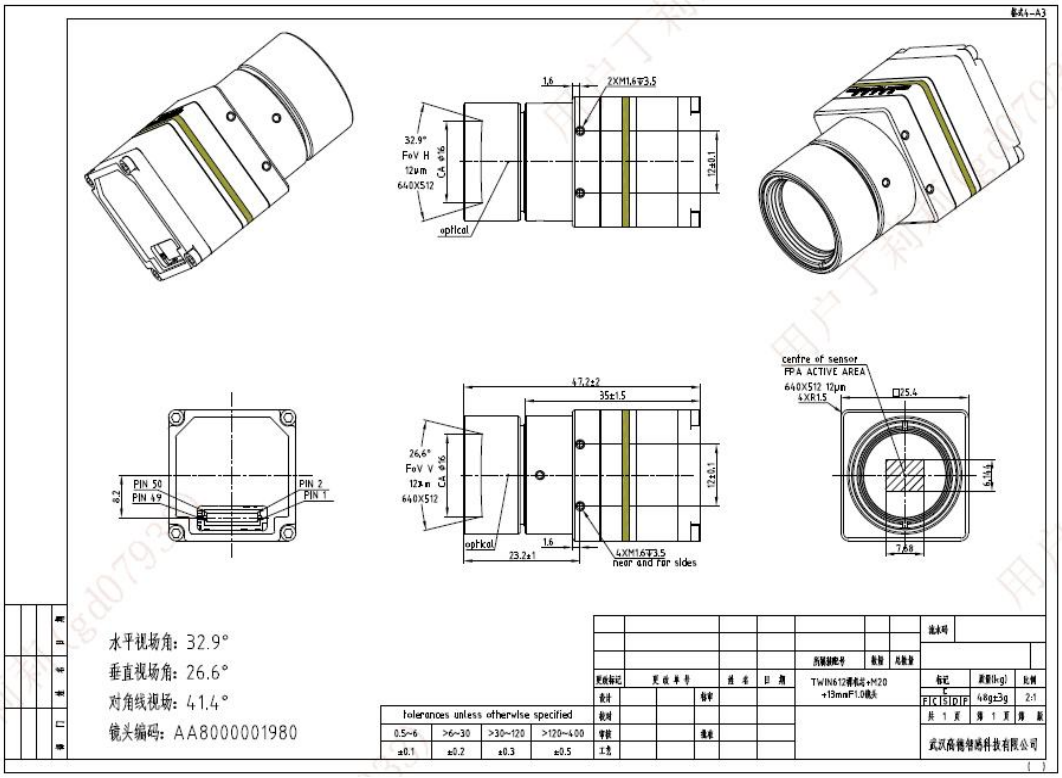


Fig. 7-1 TWIN612 module structure with 13mm lens

7.2 The structure of bare TWIN612 with 25mm lens

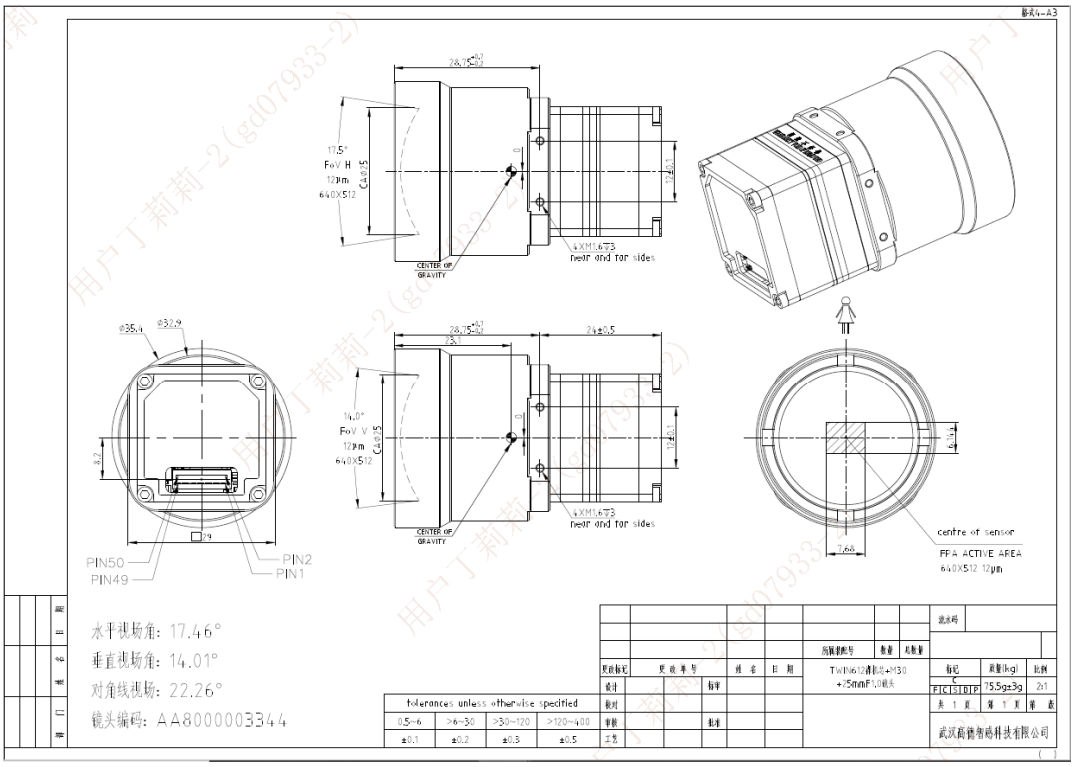


Fig. 7-2 TWIN612 module structure with 25mm lens

7.3 The structure of bare TWIN612 with 35mm lens

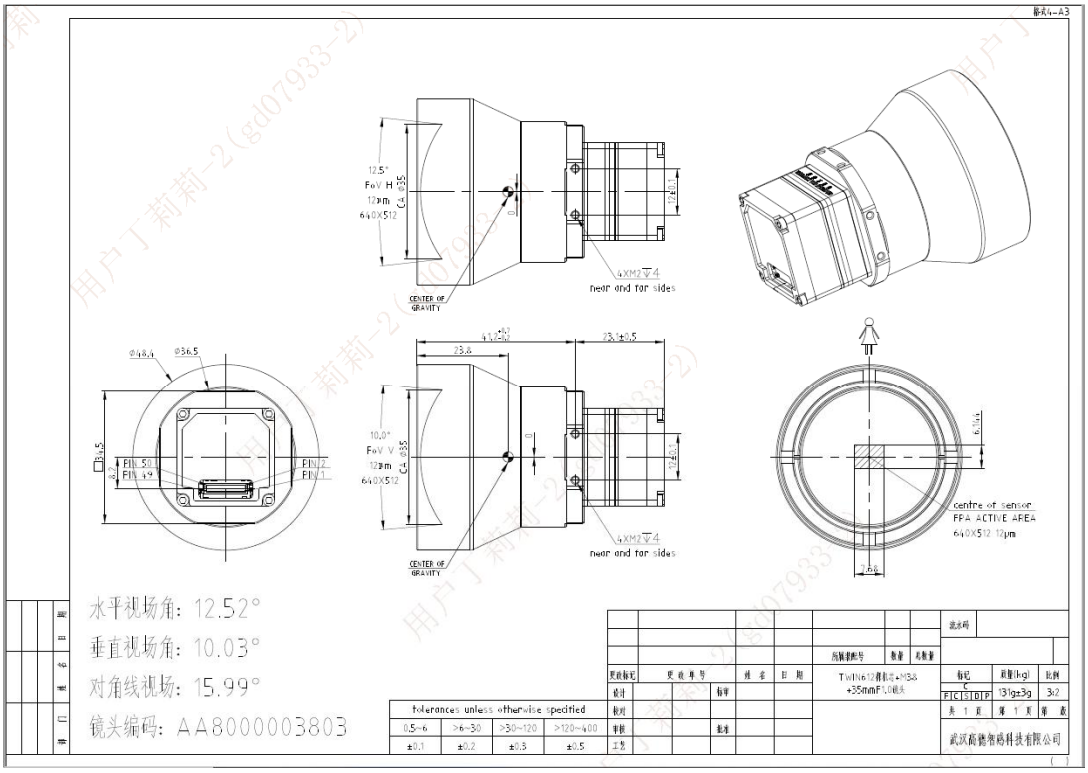


Fig. 7-3 TWIN612 module structure with 35mm lens

7.4 The structure of bare TWIN612 with 50mm lens

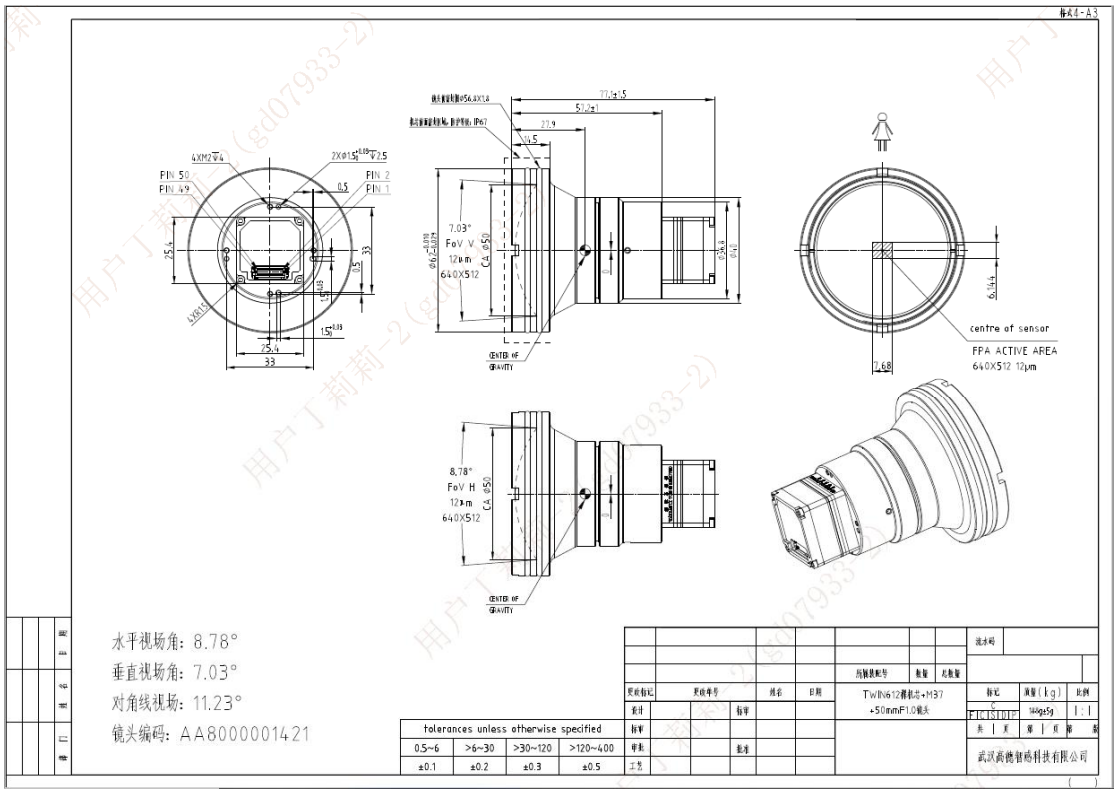


Fig. 7-4 TWIN612 module structure with 50mm lens

7.5 The structure of bare TWIN612 with 70mm lens

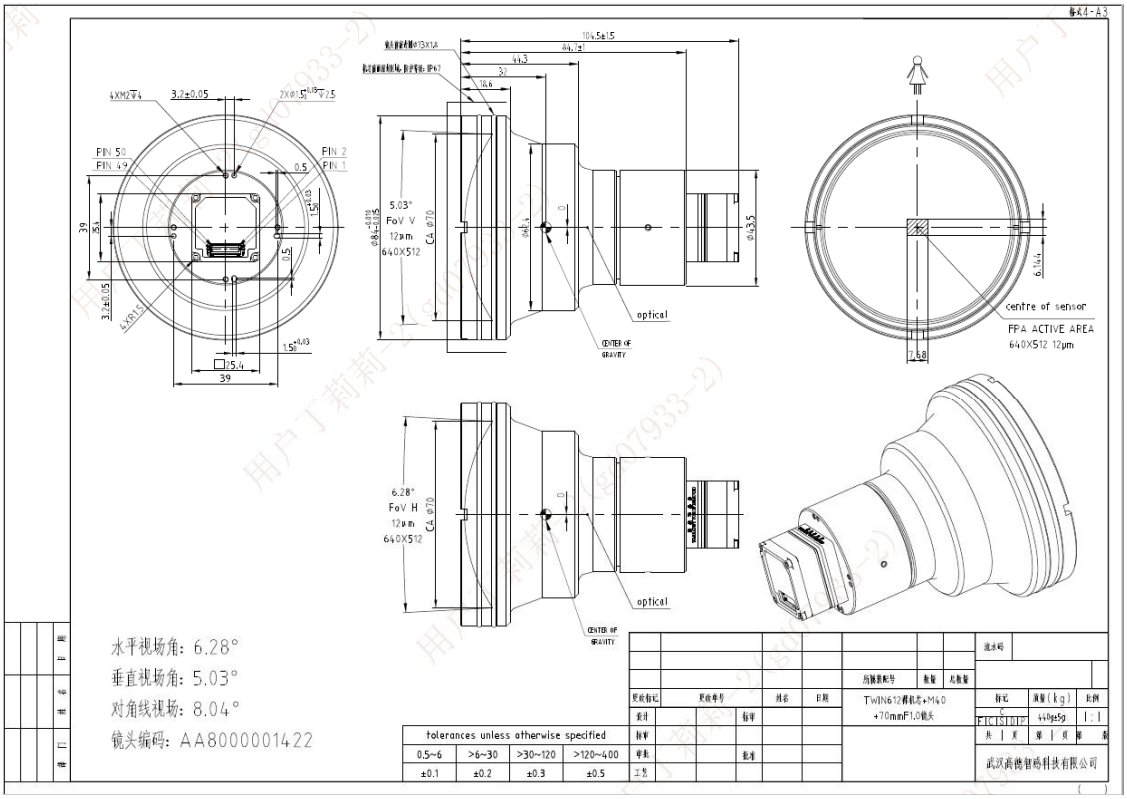


Fig. 7-5 TWIN612 module structure with 70mm lens