

PLUG Series

Product Specification v1.2



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°C) or low temperature (lower than -40°C) 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 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
2017/09	V1.0	/	WEN
2018/10	V1.2	/	TED,REOLA

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1 Product Overview

1.1 Product description

PLUG 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. 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 PLUG module is shown in Figure 1-1.

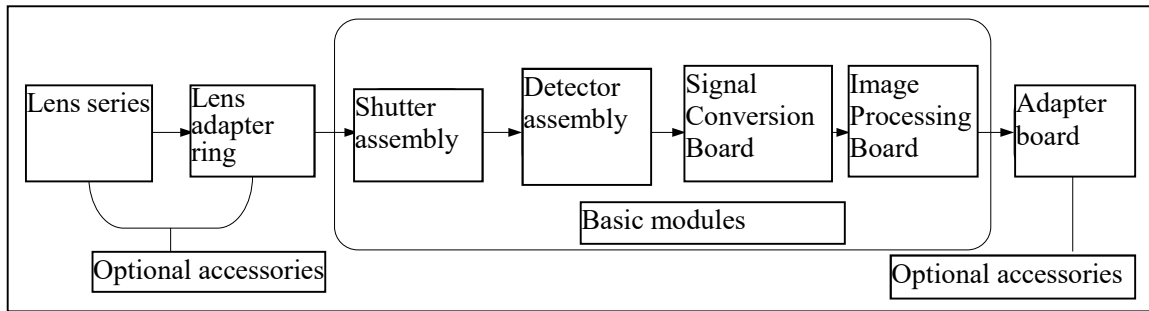


Figure 1-1 Basic framework of PLUG module

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

Detector: uncooled, vanadium oxide, 384×288 , $17\mu\text{m}$

Dimension: $44.5\text{mm} \times 44.5\text{mm} \times 36.6\text{mm}$ (without lens)

Optional lens: 7mm (manual focus), 19mm (manual focus), etc

PAL system (9Hz/25Hz/50Hz) or NTSC system (9Hz/30Hz/60Hz), switchable

RS232-TTL communication

DC: 4-6V power supply,

Typical power consumption $\leq 1.8\text{W}@5\text{V}@23 \pm 3^\circ\text{C}$ (normal version)

Optional expansion board: VPC board., etc.

Support analog video and digital video output

Analog video CVBS, 75Ω characteristic impedance

Digital video: parallel 16bit, parallel 8bit and BT.656 format available

Optional digital MIPI interface

Boot time $\leq 10\text{S}$ (normal version) ; $\leq 15\text{S}$ (temperature measurement version)

Boot screen supports customization (normal version)

Support the functions of image zoom, rollover and enhancement

Powerful SDK for secondary development and function expansion

Operation temperature: $-40^\circ\text{C} \sim +70^\circ\text{C}$, humidity 0% ~ 80% RH

Storage temperature: $-45^\circ\text{C} \sim +85^\circ\text{C}$, humidity 0% ~ 85% RH

Excellent impact and vibration resistance

ROHS Certification

Temperature measurement: available for 25Hz/30Hz (temperature measurement version)

Temperature accuracy: $\pm 2^\circ\text{C}$ 或 $\pm 2\%$ (maximum value) in case of $23^\circ\text{C} \pm 3^\circ\text{C}$

Temperature range: two kinds of range ($-40^\circ\text{C} \sim +150^\circ\text{C}$, $-40^\circ\text{C} \sim 550^\circ\text{C}$) can be chosen,

Specific requirements can be customized.

1.2.2 Optical configuration

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

Table 1-1 Optical configuration

Focal length	Resolution	f/#	FOV (H × V, ±5%)	Lens mount
7mm (fixed focus)	384×288@12um	1.1	54°×40°	Hoop M34×0.5
12.8mm (fixed focus)		1.0	28.6°×21.7°	
15mm (fixed focus)		1.0	24.6°×18.5°	
19mm (fixed focus)		1.0	19.5°×14.7°	
25mm		1.2	14.9°×11.2°	
35mm		1.2	10.7°×8°	
55mm (Electric focus)		1.2	6.8°×5.1°	
75mm (Electric focus)		1.0	5°×3.7°	
100mm (Electric focus)		1.0	3.7°×2.8°	
150mm (Electric focus)		1.0	2.5°×1.9°	

Note:

The gray fraction is in design.

1.3 Description of PC control software

The PLUG module is configured with dedicated PC serial communication control software to achieve remote control of the module.

The PC control software can be used in windows 7/8/10/XP and other operating systems, and is installed with the USB to serial port driver chip CP2102 driver.

The typical baud rate is 115200.

1.4 Precautions for 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 PLUG412 module $\leq 1.3W@5V, 23\pm 3^{\circ}C, 25Hz$.

The steady-state power consumption of PLUG412R module $\leq 1.5W@5V, 23\pm 3^{\circ}C, 25Hz$.

When starting up PLUG module, the transient power consumption $\leq 4W@6s$;

When compensating the shutter, the transient power consumption $\leq 3W@1s$;

Insufficient power supply may cause abnormality in startup and operation.

When using VPC or CAMERALINK expansion board, the power supply voltage range of the module is: DC:4V-6V. 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 HRS 50-PIN interface instructions

2.2.1 Details of interface hardware

The external interface of bare PLUG module is HRS's 50PIN interface. HRS 50-PIN includes functions of power input, digital port (Y16/Y8/BT.656) data output, TTL serial port, analog video output and power output.

The external interface model of HRS 50-PIN is:

DF12B-50DS-0.5V (86), (HRS, male connector).

The recommended external interface model is :

DF12B (5.0)-50DP-0.5V (86), (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 (10.7, -0.73).

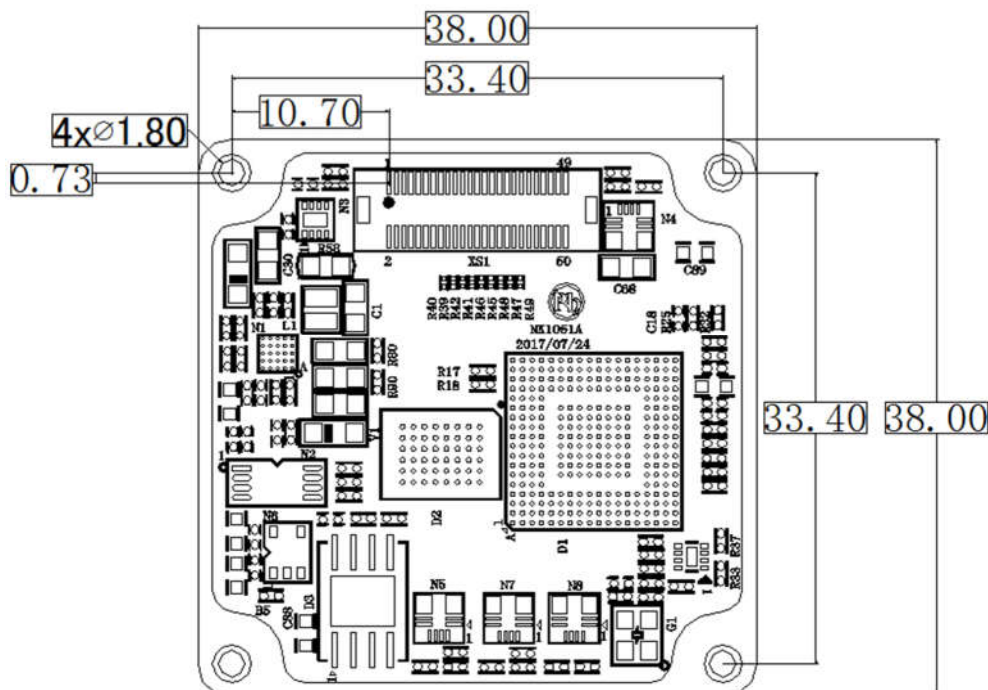


Fig. 2-1 The coordinate diagram of HRS 50-PIN interface

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	O	H 3.3V/L 0V	Send UART0 (core port, the same below)
2	UART0_RXD	I	H 3.3V/L 0V	Receive UART0
3	DIGITAL_HS	O	H 3.3V/L 0V	Digital signal line synchronization
4	DIGITAL_VS	O	H 3.3V/L 0V	Digital signal field synchronization
5	DGND	GND	0V	Power ground
6	DGND	GND	0V	Power ground
7	SCL2/UART1_RX	I/O	H 3.3V/L 0V	SCL2/UART1_RX
8	SDA2/UART1_TX	I/O	H 3.3V/L 0V	SDA2/UART1_TX
9	CLKP_PHY	O	MIPI	MIPI clock +
10	CLKN_PHY	O	MIPI	MIPI clock -
11	LCOS_VALID	O	H 3.3V/L 0V	Synchronizing signal
12	NC	NC	NC	NC
13	DATAP0_PHY	O	MIPI	MIPI data 0+
14	DATAN0_PHY	O	MIPI	MIPI data 0-
15	DATAP1_PHY	O	MIPI	MIPI data 1+
16	DATAN1_PHY	O	MIPI	MIPI data 1-
17	DGND	GND	0V	Power ground
18	DGND	GND	0V	Power ground
19	DATA_OUT15	O	H 3.3V/L 0V	Digital video signal
20	DATA_OUT13	O	H 3.3V/L 0V	Digital video signal
21	DATA_OUT14	O	H 3.3V/L 0V	Digital video signal
22	DATA_OUT12	O	H 3.3V/L 0V	Digital video signal
23	DATA_OUT11	O	H 3.3V/L 0V	Digital video signal
24	DATA_OUT10	O	H 3.3V/L 0V	Digital video signal
25	DATA_OUT9	O	H 3.3V/L 0V	Digital video signal
26	DATA_OUT8	O	H 3.3V/L 0V	Digital video signal
27	DGND	GND	H 3.3V/L 0V	Digital video signal
28	DGND	GND	H 3.3V/L 0V	Digital video signal
29	DATA_OUT7	O	H 3.3V/L 0V	Digital video signal
30	DATA_OUT6	O	H 3.3V/L 0V	Digital video signal
31	DATA_OUT5	O	H 3.3V/L 0V	Digital video signal
32	DATA_OUT4	O	H 3.3V/L 0V	Digital video signal
33	DATA_OUT3	O	H 3.3V/L 0V	Digital video signal
34	DATA_OUT2	O	H 3.3V/L 0V	Digital video signal
35	DATA_OUT1	O	H 3.3V/L 0V	Digital video signal
36	DATA_OUT0	O	H 3.3V/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	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	3V3_OUT	POWER	3.3V	Power output
47	DGND	GND	0V	Power ground

48	POWER_IN	POWER	4-6V	Power input
49	DGND	GND	0V	Power ground
50	POWER_IN	POWER	4-6V	Power input

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

As the digital signal Y8/Y16/BT.656 hardware interface of the module is multiplex, only one digital type output is optional each time, and the digital output mode of the module is Y16(CMOS16) by default. The digital signal output type can be switched by PC control software.

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	
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	26	/	Y16_D8	/
DATA_OUT9	25	/	Y16_D9	/
DATA_OUT10	24	/	Y16_D10	/
DATA_OUT11	23	/	Y16_D11	/
DATA_OUT12	22	/	Y16_D12	/
DATA_OUT14	21	EXT_SYNC	Y16_D14	EXT_SYNC
DATA_OUT13	20	/	Y16_D13	/
DATA_OUT15	19	/	Y16_D15	/
DIGITAL_VS	4	Y8_FIELD_VALID	Y16_FIELD_VALID	/
DIGITAL_HS	3	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. Such raw data are not subject to dimming.

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

The BT.656 interface outputs data in the standard BT.656 format. See ITU-R Recommendation ITU-R BT.656-5(12/2007) for details. In present, support four kinds of resolution:384x288,360x288,360x240, 320x240.

BT.601 interface (YUV format), 16bit parallel data: D15~D8 is Y signal, D7~D0 is UV data;

EXT_SYNC: the signal direction is input.

2.3 Details of digital video

PLUG module supports multiple digital video format output; the output video clock is related to the system, frame frequency and CMOS interface bit width. The specific list is as follows:

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

Data source	PAL(384 x288)		NTSC(320 x240)
	50Hz	25 Hz/9Hz	60Hz/ 30Hz /9Hz

	16bit	8bit	16bit	8bit	16bit	8bit
Y16	7.375	14.75	3.6875	7.375	6.136	12.272
Y16+ parameter line	7.375	14.75	3.6875	7.375	6.136	12.272
Yuv422	7.375	14.75	7.375	14.75	6.136	12.272
Yuv422+ parameter line	7.375	14.75	7.375	14.75	6.136	12.272
Y16+Yuv422	7.375	14.75	This function is not supported		6.136	12.272
Y16+ parameter line + Yuv422	7.375	14.75			6.136	12.272

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, 8 /16 parallel bits of data, transmitted via single-ended 3.3V CMOS logic levels, CMOS8 stands for parallel 8-bits, CMOS16 stands for parallel 16-bits;

2. Parameter 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] ;

Index format of digital video

Data Format (line, filed, data for BT601)	Bits	Data source	Std.	Frame Rate (Hz)	resolution	Data stream	Table index	Data timing index	Frame timing index
BT601	CMOS8	Y16	P	50	384x288	MSB/LSB	Tab. 2-4	Fig. 2-2	Fig. 2-6
BT601	CMOS8	Y16	N	60	320x480	MSB/LSB	Tab. 2-4	Fig. 2-2	Fig. 2-6
BT601	CMOS8	Y16	P	25	384x288	MSB/LSB	Tab. 2-5	Fig. 2-2	Fig. 2-6
BT601	CMOS8	Y16	N	30	384x288	MSB/LSB	Tab. 2-4	Fig. 2-2	Fig. 2-6
BT601	CMOS8	YUV422	P	50	384x288	MSB/LSB	Tab. 2-4	Fig. 2-3	Fig. 2-6
BT601	CMOS8	YUV422	P	25	384x288	MSB/LSB	Tab. 2-5	Fig. 2-3	Fig. 2-6
BT601	CMOS8	YUV422	N	30	320x240	MSB/LSB	Tab. 2-4	Fig. 2-3	Fig. 2-6
BT601	CMOS8	YUV422	N	60	320x240	MSB/LSB	Tab. 2-4	Fig. 2-3	Fig. 2-6
BT601	CMOS8	Y16+para.	P	50	384x289	MSB/LSB	Tab. 2-4	Fig. 2-4	Fig. 2-7
BT601	CMOS8	Y16+para.	N	60	384x289	MSB/LSB	Tab. 2-4	Fig. 2-4	Fig. 2-7
BT601	CMOS8	Y16+para.	P	25	384x289	MSB/LSB	Tab. 2-5	Fig. 2-4	Fig. 2-7
BT601	CMOS8	Y16+para.	N	30	384x289	MSB/LSB	Tab. 2-4	Fig. 2-4	Fig. 2-7
BT601	CMOS8	YUV422+ para.	P	50	384x289	MSB/LSB	Tab. 2-4	Fig. 2-5	Fig. 2-7
BT601	CMOS8	YUV422+ para.	N	60	384x289	MSB/LSB	Tab. 2-4	Fig. 2-5	Fig. 2-7
BT601	CMOS8	YUV422+ para.	P	25	384x289	MSB/LSB	Tab. 2-5	Fig. 2-5	Fig. 2-7
BT601	CMOS8	YUV422+ para.	N	30	384x289	MSB/LSB	Tab. 2-4	Fig. 2-5	Fig. 2-7
BT601	CMOS8	Y16+YUV422	P	50	384x576	MSB/LSB	Tab. 2-6	Fig. 2-2 Fig. 2-3	Fig. 2-8

Data Format (line, filed, data for BT601)	Bits	Data source	Std.	Frame Rate (Hz)	resolution	Data stream	Table index	Data timing index	Frame timing index
BT601	CMOS8	Y16+YUV422	N	60	320x480	MSB/LSB	Tab. 2-6	Fig. 2-2 Fig. 2-3	Fig. 2-8
BT601	CMOS8	Y16+para. +YUV422	P	50	384x577	MSB/LSB	Tab. 2-6	Fig. 2-3 Fig. 2-4	Fig. 2-9
BT601	CMOS8	Y16+YUV422	P	50	384x576	MSB	Tab. 2-6	Fig. 2-4	Fig. 2-14
BT601	CMOS8	Y16+YUV422	N	60	320x480	MSB	Tab. 2-6	Fig. 2-6	Fig. 2-15
BT601	CMOS16	YUV422	P	50	384x288		Tab. 2-7	Fig. 2-10	Fig. 2-11
BT601	CMOS16	Y16	P	25	384x288		Tab. 2-8	Fig. 2-8	Fig. 2-9
BT601	CMOS8	Y16+para. +YUV422	N	60	320x481	MSB/LSB	Tab. 2-6	Fig. 2-3 Fig. 2-4	Fig. 2-9
BT601	CMOS16	Y16	P	50	384x288	MSB/LSB	Tab. 2-7	Fig. 2-10	Fig. 2-14
BT601	CMOS16	Y16	N	60	320x480	MSB/LSB	Tab. 2-7	Fig. 2-10	Fig. 2-14
BT601	CMOS16	Y16	P	25	384x288	MSB/LSB	Tab. 2-8	Fig. 2-10	Fig. 2-14
BT601	CMOS16	Y16	N	30	384x288	MSB/LSB	Tab. 2-7	Fig. 2-10	Fig. 2-14
BT601	CMOS16	YUV422	P	50	384x288	MSB/LSB	Tab. 2-7	Fig. 2-11	Fig. 2-14
BT601	CMOS16	YUV422	P	25	384x288	MSB/LSB	Tab. 2-8	Fig. 2-11	Fig. 2-14
BT601	CMOS16	YUV422	N	30	320x240	MSB/LSB	Tab. 2-7	Fig. 2-11	Fig. 2-14
BT601	CMOS16	YUV422	N	60	320x240	MSB/LSB	Tab. 2-7	Fig. 2-11	Fig. 2-14
BT601	CMOS16	Y16+para.	P	50	384x289	MSB/LSB	Tab. 2-7	Fig. 2-12	Fig. 2-15
BT601	CMOS16	Y16+para.	N	60	384x289	MSB/LSB	Tab. 2-7	Fig. 2-12	Fig. 2-15
BT601	CMOS16	Y16+para.	P	25	384x289	MSB/LSB	Tab. 2-8	Fig. 2-12	Fig. 2-15
BT601	CMOS16	Y16+para.	N	30	384x289	MSB/LSB	Tab. 2-7	Fig. 2-12	Fig. 2-15
BT601	CMOS16	YUV422+ para.	P	50	384x289	MSB/LSB	Tab. 2-7	Fig. 2-13	Fig. 2-15
BT601	CMOS16	YUV422+ para.	N	60	384x289	MSB/LSB	Tab. 2-7	Fig. 2-13	Fig. 2-15
BT601	CMOS16	YUV422+ para.	P	25	384x289	MSB/LSB	Tab. 2-8	Fig. 2-13	Fig. 2-15
BT601	CMOS16	YUV422+ para.	N	30	384x289	MSB/LSB	Tab. 2-7	Fig. 2-13	Fig. 2-15
BT601	CMOS16	Y16+YUV422	P	50	384x576	MSB/LSB	Tab. 2-9	Fig. 2-10 Fig. 2-11	Fig. 2-16

Data Format (line, filed, data for BT601)	Bits	Data source	Std.	Frame Rate (Hz)	resolution	Data stream	Table index	Data timing index	Frame timing index
BT601	CMOS16	Y16+YUV422	N	60	320x480	MSB/LSB	Tab. 2-9	Fig. 2-10 Fig. 2-11	Fig. 2-16
BT601	CMOS16	Y16+para. + YUV422	P	50	384x577	MSB/LSB	Tab. 2-9	Fig. 2-11 Fig. 2-12	Fig. 2-17
BT601	CMOS16	Y16+para. + YUV422	N	60	320x481	MSB/LSB	Tab. 2-9	Fig. 2-11 Fig. 2-12	Fig. 2-17
BT656 (CMOS8, interleaved)	CMOS8	YUV422	P	50	384x288		Tab. 2-10 Tab. 2-11	Fig. 2-18	/
BT656 (CMOS8, interleaved)	CMOS8	YUV422	P	50	360x288		Tab. 2-10 Tab. 2-11	Fig. 2-18	/
BT656 (CMOS8, interleaved)	CMOS8	YUV422	N	60	360x240		Tab. 2-10 Tab. 2-11	Fig. 2-18	/
BT656 (CMOS8, interleaved)	CMOS8	YUV422	N	60	320x240		Tab. 2-10 Tab. 2-11	Fig. 2-18	/

2.3.1 Parallel 8-bit (CMOS8)

The timing parameters of parallel 8bit digital video are shown in Table 2-4. The timing of this table is applicable to data sources as Y16 and Yuv422.

Table 2-4 Digital port 8bit sequence parameters 1

Video format	PAL 50Hz (Y16/YUV422)			NTSC 60Hz (Y16/YUV422)			
	Description	Typical value	Unit	Remarks	Typical value	Unit	Remarks
Resolution	384×288			320×240			
NW	384			320			
NH	288			240			
DIGITAL_CLK	14.75	MHz		12.272	MHz		
TLine	64	us	944 CLK	63.56	us	780CLK	
TLine_Valid	52.07	us	768CLK	52.15	us	640CLK	
TLine_Blank	11.93	us	176CLK	11.41	us	140CLK	
TPixel	0.0678	us	1 CLK	0.0815	us	1 CLK	
TStart		us	80CLK		us	41CLK	
TFrame	40ms	ms	625 Line	33.368	ms	525 Line	
TField_Even	19.968	ms	312 Line	16.652	ms	262 Line	
TField_Odd	20.032	ms	313 Line	16.716	ms	263 Line	
TEven_Valid	19.2	ms	300 Line	15.254	ms	240 Line	
TEven_Blank	0.768	ms	12 Line	1.398	ms	22 Line	
TOdd_Valid	19.2	ms	300 Line	15.254	ms	240 Line	
TOdd_Blank	0.832	ms	13 Line	1.462	ms	23 Line	

Tab.2-5 Digital port 8bit sequence parameters 2

Video format	PAL 25Hz (Y16)			PAL 25Hz (YUV422)			
	Description	Typical value	Unit	Remarks	Typical value	Unit	Remarks
Resolution	384*288			384*288			
NW	384			384			
NH	288			288			
DIGITAL_CLK	7.375	MHz		14.75	MHz		
TLine	128	us	944 CLK	64	us	944 CLK	
TLine_Valid	104.1	us	768CLK	52.07	us	768CLK	
TLine_Blank	23.9	us	176CLK	11.93	us	176CLK	
TPixel	0.1356	us	1 CLK	0.0678	us	1 CLK	
TStart		us	80CLK		us	80CLK	
TFrame	40ms	ms	625 Line	40ms	ms	625 Line	
TField_Even		ms	312 Line	19.968	ms	312 Line	

TField_Odd		ms	313 Line	20.032	ms	313 Line
TEven_Valid	36.864	ms	300 Line	19.2	ms	300 Line
TEven_Blank	3.136	ms	12 Line	0.768	ms	12 Line
TOdd_Valid		ms	300 Line	19.2	ms	300 Line
TOdd_Blank		ms	13 Line	0.832	ms	13 Line

Note :

The timing sequence of parallel 8bits for data source Y16 is shown in Fig. 2-2.

The timing sequence of parallel 8bits for data source YUV422 is shown in Fig. 2-3.

The timing sequence of parallel 8bits for data source Y16+parameters is shown in Fig. 2-4.

The timing sequence of parallel 8bits for data source YUV422+parameters is shown in Fig. 2-5.

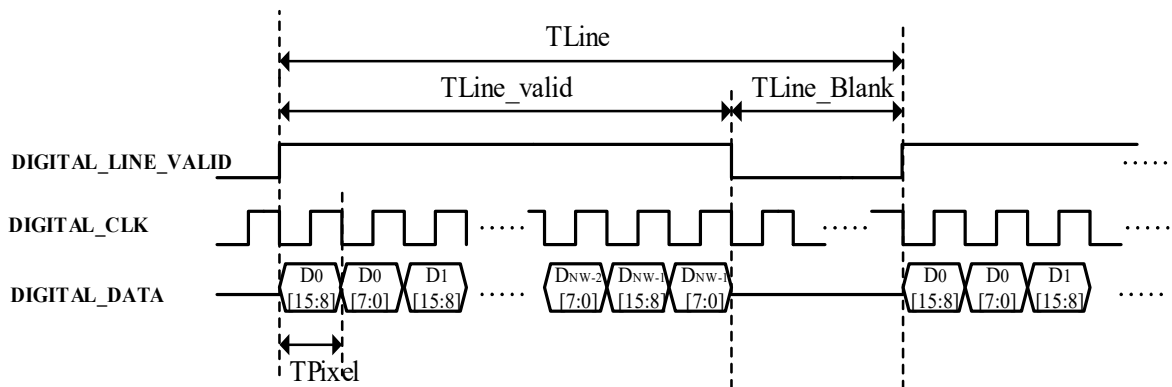


Fig. 2-2a CMOS8, Y16 (MSB)timing sequence diagram

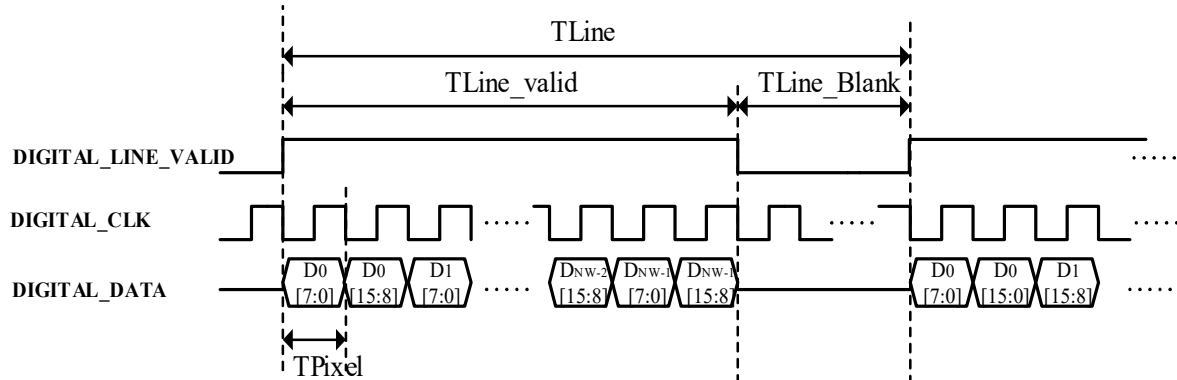


Fig. 2-2b CMOS8, Y16 (LSB)timing sequence diagram

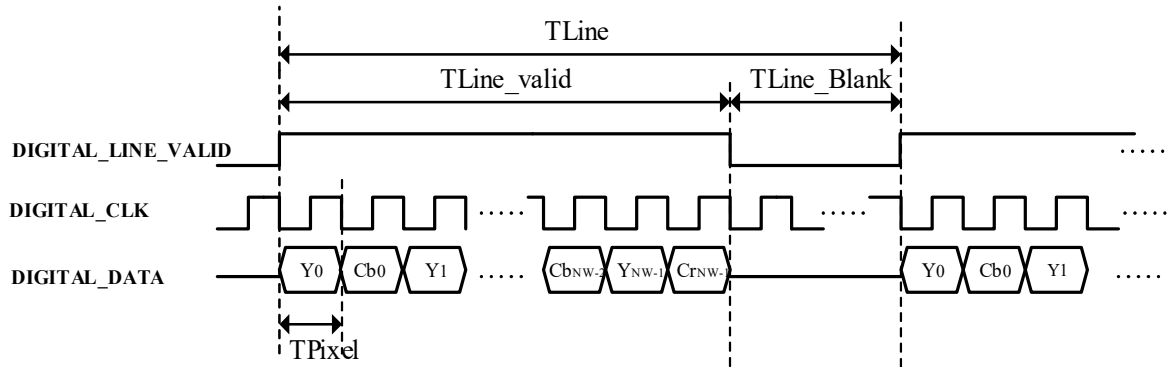


Fig. 2-3a CMOS8, YUV422 (MSB) timing sequence diagram

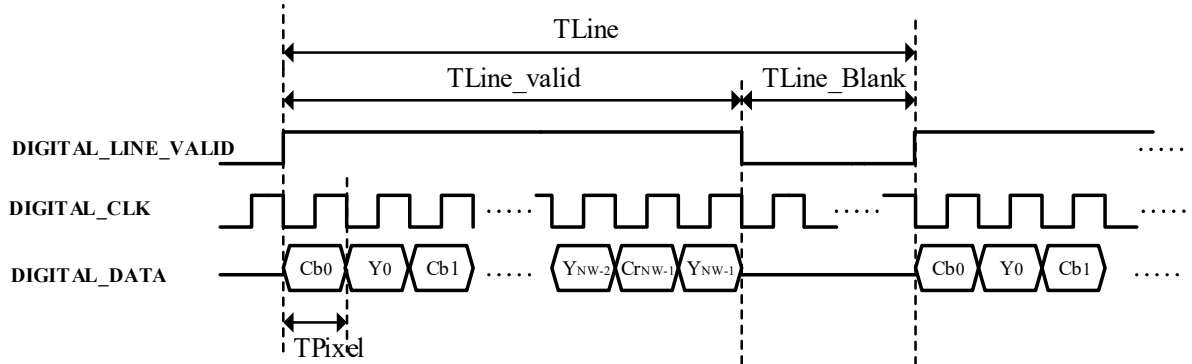


Fig. 2-3b CMOS8, YUV422 (LSB) timing sequence diagram

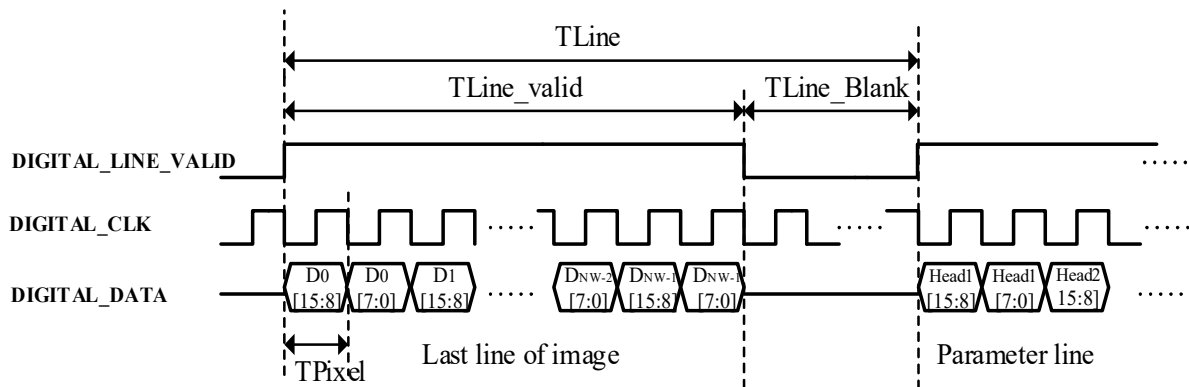


Fig. 2-4a CMOS8, Y16 + parameters (MSB) timing sequence diagram

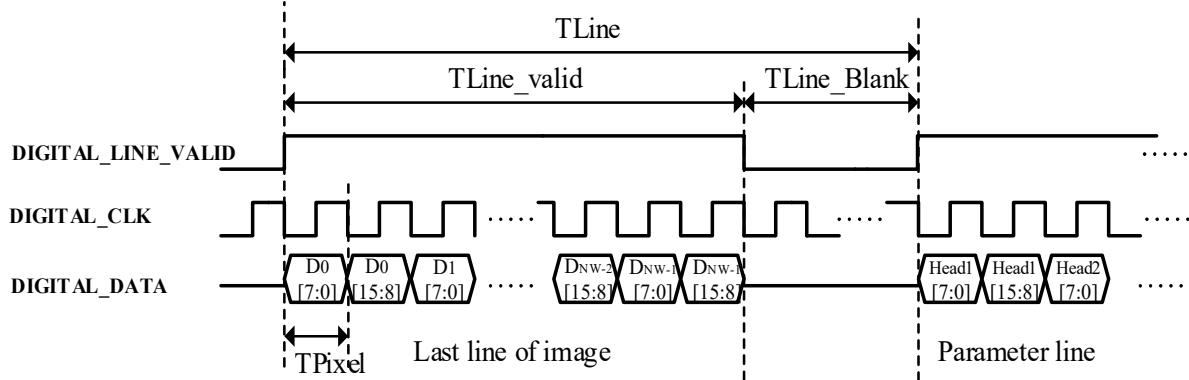


Fig. 2-4b CMOS8, Y16+ parameters (LSB) timing sequence diagram

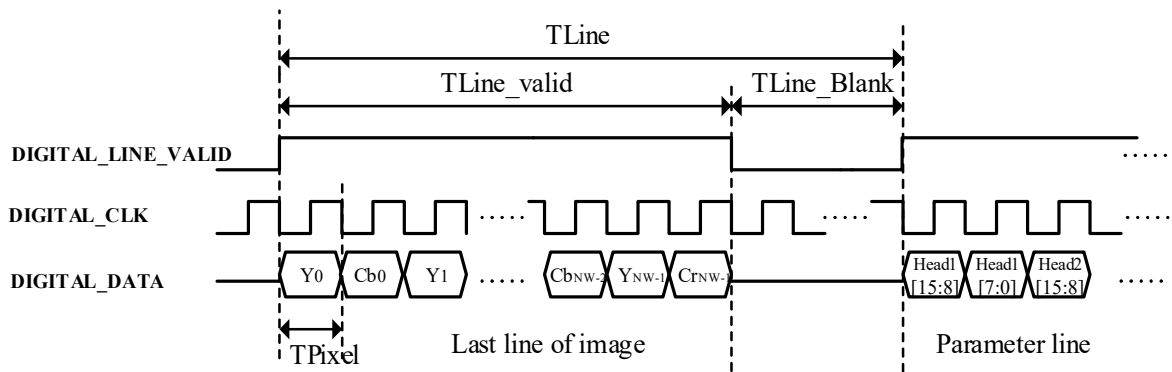


Fig. 2-5a CMOS8, YUV422+ parameters (MSB) sequence diagram

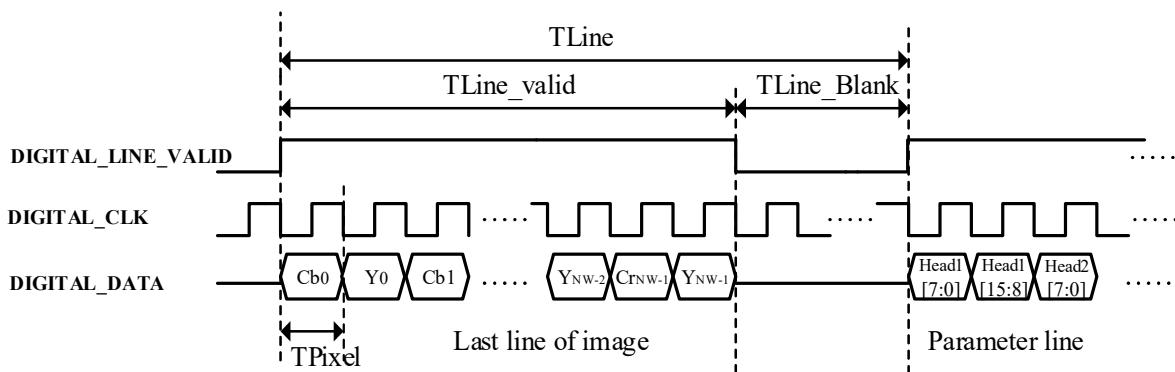


Fig. 2-5b CMOS8, YUV422+ parameters (LSB) sequence diagram

The frame timing sequence of parallel 8bits for Y16/YUV422 is shown in Fig.2-6.

The frame timing sequence of parallel 8bits for Y16+parameters /YUV422+parameters is shown in Fig.2-7.

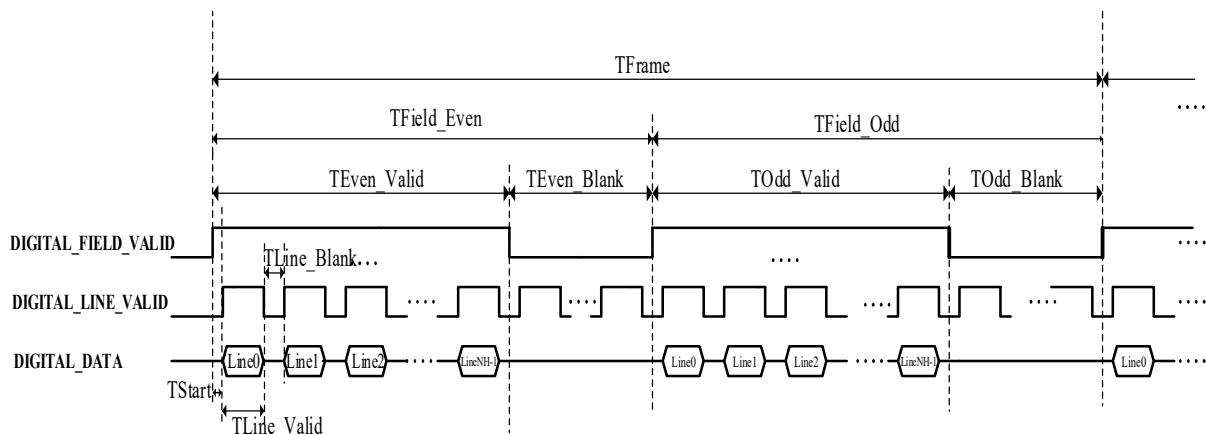


Fig.2-6 CMOS8, Y16/YUV422 frame sequence diagram

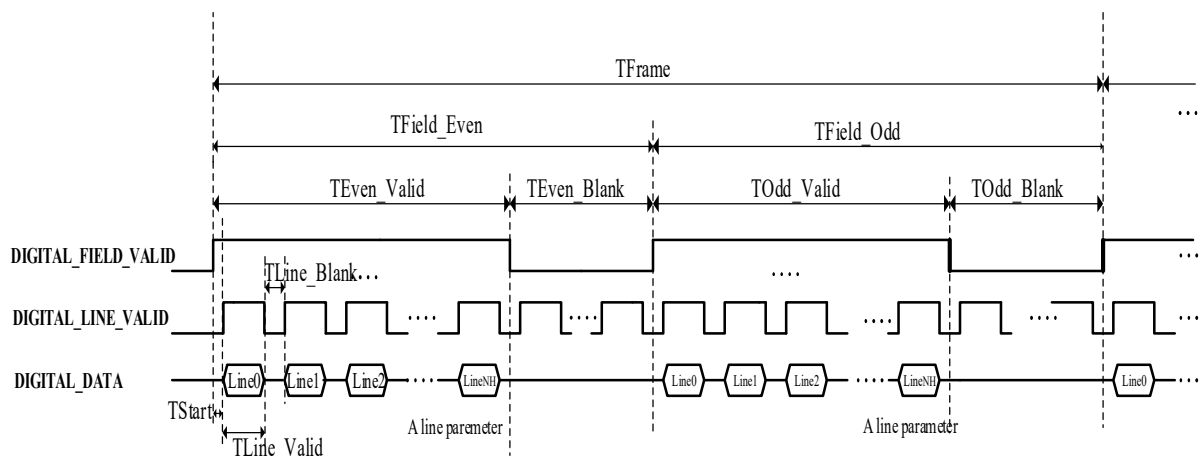


Fig.2-7 CMOS8, Y16/YUV422+parameters frame sequence diagram

The timing parameters of parallel 16bit digital video for Y16+ YUV422 are shown in Table 2-6.

Table 2-6 Digital port 8bit (Y16+YUV422) sequence parameters

Video format	PAL 50Hz			NTSC 60Hz		
Description	Typical value	Unit	Remarks	Typical value	Unit	Remarks
Resolution	384 × 576			320 × 480		
NW	384			320		
NH	576			480		
DIGITAL_CLK	14.75	MHz		12.272	MHz	
TLine	64	us	944 CLK	63.56	us	780 CLK
TLine_Valid	52.07	us	768 CLK	52.15	us	640 CLK
TLine_Blank	11.93	us	176 CLK	11.41	us	140 CLK
TPixel	0.0678	us	1 CLK	0.0815	us	1 CLK
TStart		us	80CLK		us	41CLK
TFrame	40ms	ms	625 Line	33.368	ms	525 Line
TFrame_Valid	>36.864	ms	>576Line	>30.508	ms	>480Line
TFrame_Blank	<3.136	ms	<49 Line	<2.86	ms	<45 Line

The timing sequence of parallel 8bits for Y16+ YUV422 is shown in Fig.2-2,2-3, the frame timing sequence is shown in Fig. 2-8.

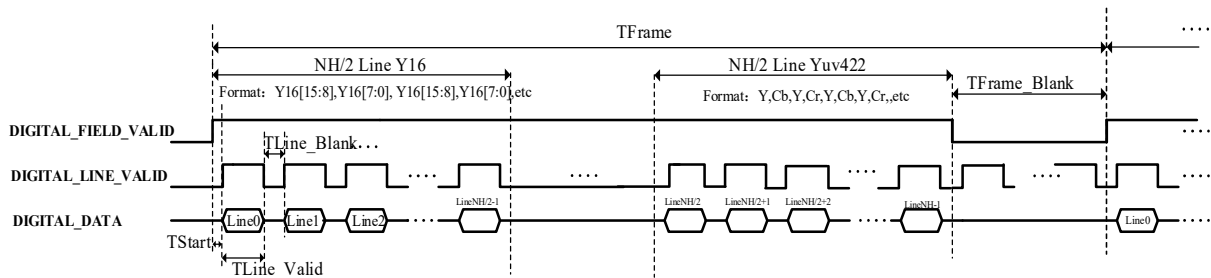


Figure 2-8 CMOS8, Y16+ YUV422 frame synchronous sequence diagram

The timing sequence of parallel 8bits for Y16+parameters +YUV422 is shown in Fig.2-3,2-4, the frame timing sequence is shown in Fig. 2-9.

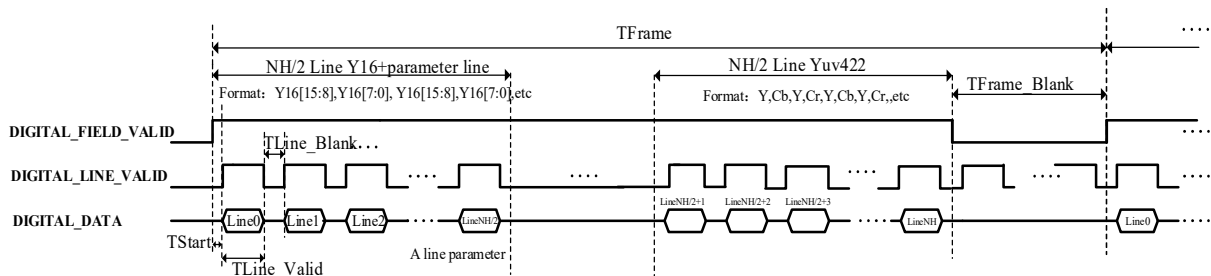


Figure 2-9 Y16+parameters +YUV422 frame synchronous sequence diagram

2.3.2 Parallel 16-bit (CMOS16)

The timing parameters of parallel 16bit digital video are shown in Table 2-7. The timing of this table is applicable to data sources as Y16 and Yuv422.

Table 2-7 Digital port 16bit sequence parameters

Video format	PAL 50Hz			NTSC 60Hz		
Description	Typical value	Unit	Remarks	Typical value	Unit	Remarks
Resolution	384×288			320×240		
NW	384			320		
NH	288			240		
DIGITAL_CLK	7.375	MHz		6.136	MHz	
TLine	64	us	472 CLK	63.56	us	390CLK
TLine_Valid	52.07	us	384CLK	52.15	us	320CLK
TLine_Blank	11.93	us	88CLK	11.41	us	70CLK
TPixel	0.1356	us	1 CLK	0.163	us	1 CLK
TStart		us	80CLK		us	41CLK
TFrame	40ms	ms	625 Line	33.368	ms	525 Line
TField_Even	19.968	ms	312 Line	16.652	ms	262 Line
TField_Odd	20.032	ms	313 Line	16.716	ms	263 Line
TEven_Valid	19.2	ms	300 Line	15.254	ms	240 Line
TEven_Blank	0.768	ms	12 Line	1.398	ms	22 Line
TOdd_Valid	19.2	ms	300 Line	15.254	ms	240 Line
TOdd_Blank	0.832	ms	13 Line	1.462	ms	23 Line

Table 2-8 Digital port 16bit sequence parameters

Video format (data source)	PAL 25Hz(Y16)			PAL 25Hz(Yuv422)		
Description	Typical value	Unit	Remarks	Typical value	Unit	Remarks
Resolution	384×288			384×288		
NW	384			384		
NH	288			288		
DIGITAL_CLK	3.6875	MHz		7.375	MHz	
TLine	128	us	472 CLK	64	us	472 CLK
TLine_Valid	104.1	us	384CLK	52.07	us	384CLK
TLine_Blank	23.9	us	88CLK	11.93	us	88CLK
TPixel	0.2712	us	1 CLK	0.1356	us	1 CLK
TStart		us	80CLK		us	80CLK
TFrame	40ms	ms	625 Line	40ms	ms	625 Line
TField_Even		ms	312 Line	19.968	ms	312 Line
TField_Odd		ms	313 Line	20.032	ms	313 Line
TEven_Valid	36.864	ms	300 Line	19.2	ms	300 Line
TEven_Blank	3.136	ms	12 Line	0.768	ms	12 Line
TOdd_Valid		ms	300 Line	19.2	ms	300 Line
TOdd_Blank		ms	13 Line	0.832	ms	13 Line

Note:

The timing sequence of parallel 16bits for data source Y16 is shown in Fig. 2-10.

The timing sequence of parallel 16bits for data source YUV422 is shown in Fig. 2-11.

The timing sequence of parallel 16bits for data source Y16+parameters is shown in Fig. 2-12.
 The timing sequence of parallel 16bits for data source YUV422+parameters is shown in Fig. 2-13.

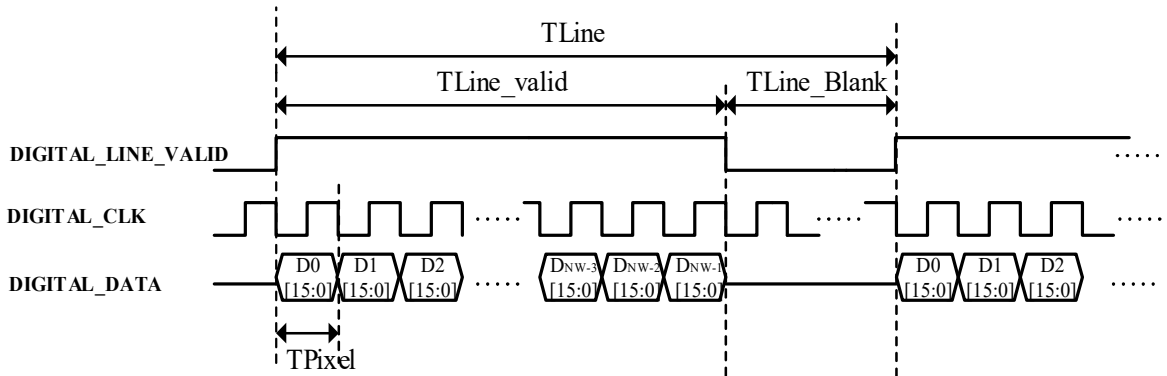


Fig.2-10 CMOS16, Y16 timing sequence diagram

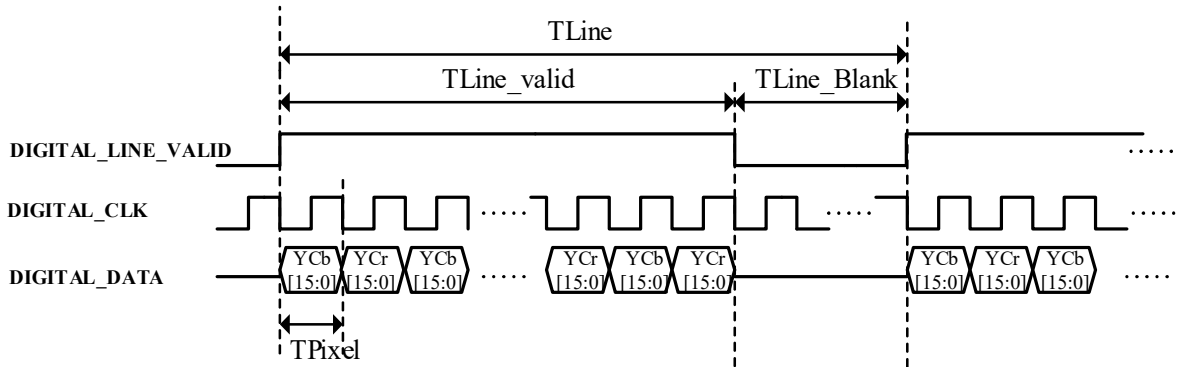


Fig.2-11 CMOS16, YUV422 timing sequence diagram

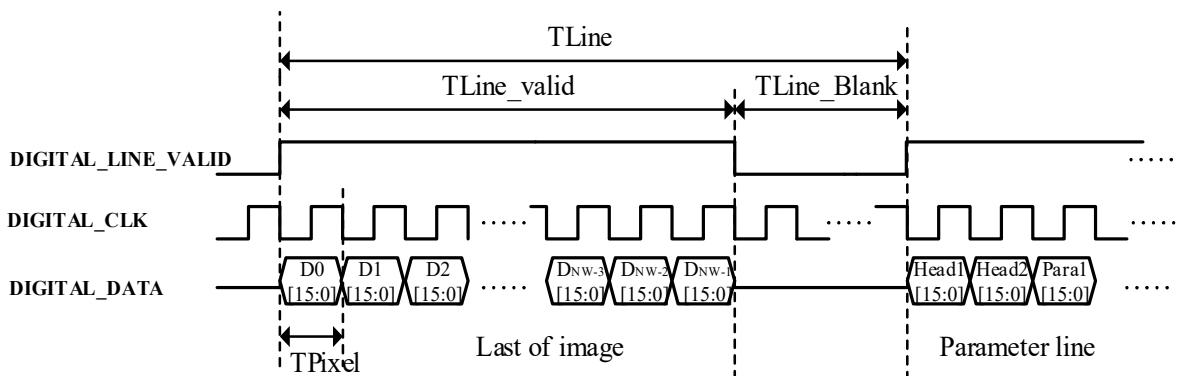


Fig.2-12 CMOS16, Y16+parameters timing sequence diagram

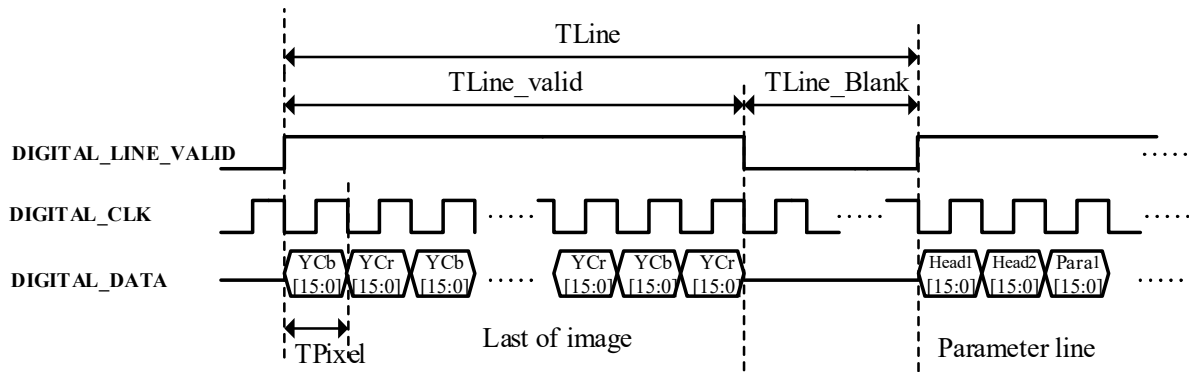


Fig.2-13 CMOS16, YUV422+parameter timing sequence diagram

The frame timing sequence of parallel 16bits for Y16/YUV422 is shown in fig.2-14.

The frame timing sequence of parallel 16bits for Y16+parameters /YUV422+parameters is shown in fig.2-15.

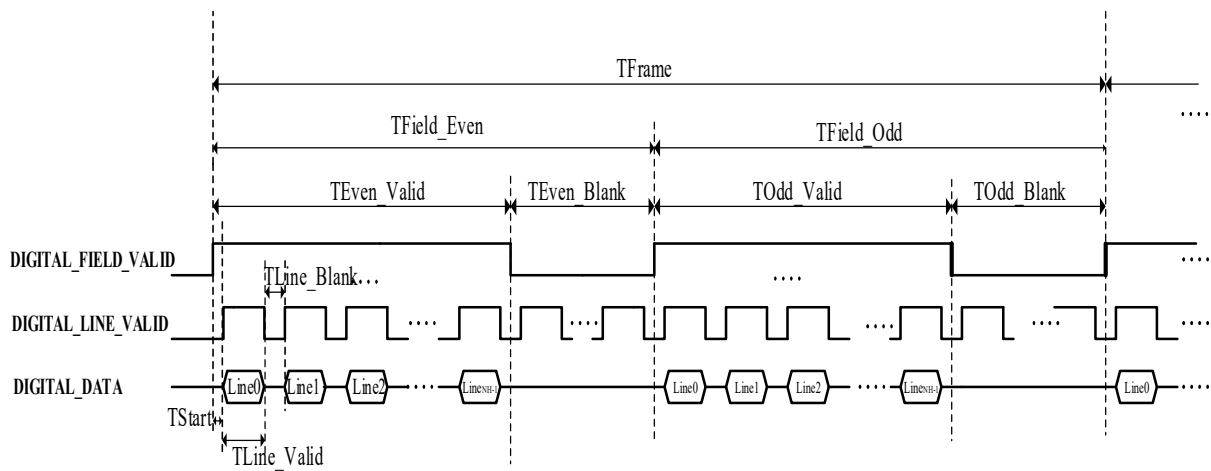


Fig.2-14 CMOS16, Y16/YUV422 frame timing

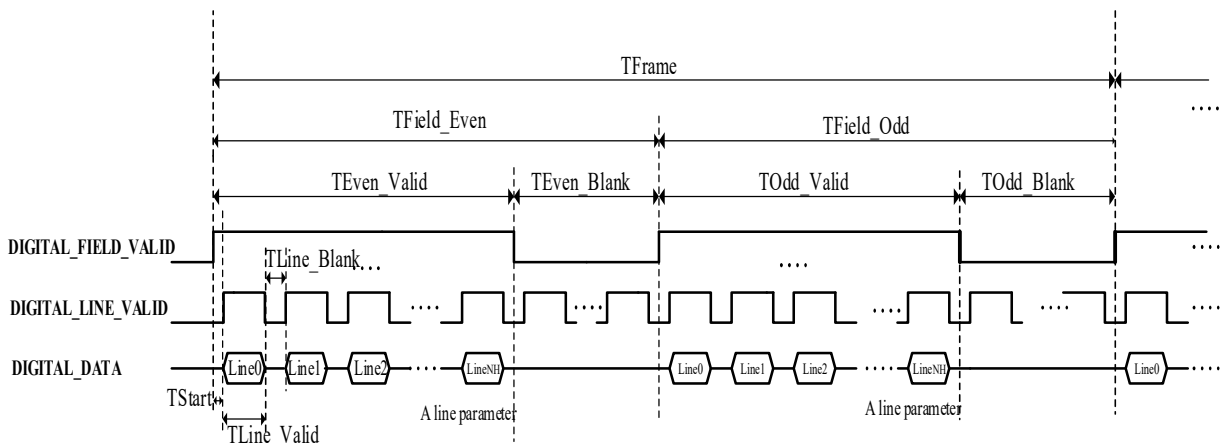


Fig.2-15 CMOS16, Y16+parameters /YUV422+parameters frame timing

The timing parameters of parallel 16bit digital video for Y16+ YUV422 are shown in Table 2-9.

Table 2-9 Digital port 16bit (Y16 +YUV422) sequence parameters

Video format	PAL 50Hz			NTSC 60Hz		
Description	Typical value	Unit	Remarks	Typical value	Unit	Remarks
Resolution	384×576			320×480		
NW	384			320		
NH	576			480		
DIGITAL CLK	7.375	MHz		6.136	MHz	
TLine	64	us	472 CLK	63.56	us	390 CLK
TLine Valid	52.07	us	384 CLK	52.15	us	320 CLK
TLine Blank	11.93	us	88 CLK	11.41	us	70 CLK
TPixel	0.1356	us	1 CLK	0.163	us	1 CLK
TStart		us	80CLK		us	41CLK
TFrame	40ms	ms	625 Line	33.368	ms	525 Line
TFrame Valid	>36.928	ms	>577Line	>30.572	ms	>481Line
TFrame Blank	<3.072	ms	<48 Line	<2.796	ms	<44 Line

The timing sequence of parallel 16bits for Y16+ YUV422 is shown in fig.2-10、2-11。The frame timing is shown in fig.2-16.

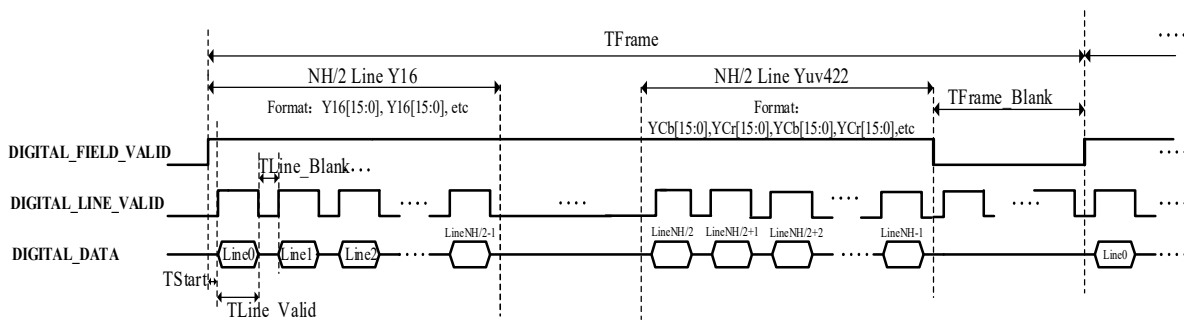


Fig.2-16 CMOS16, Y16+YUV422 frame timing

The timing sequence of parallel 16bits for Y16+parameters+YUV422 is shown in fig.2-11、2-12.The frame timing is shown in fig.2-17.

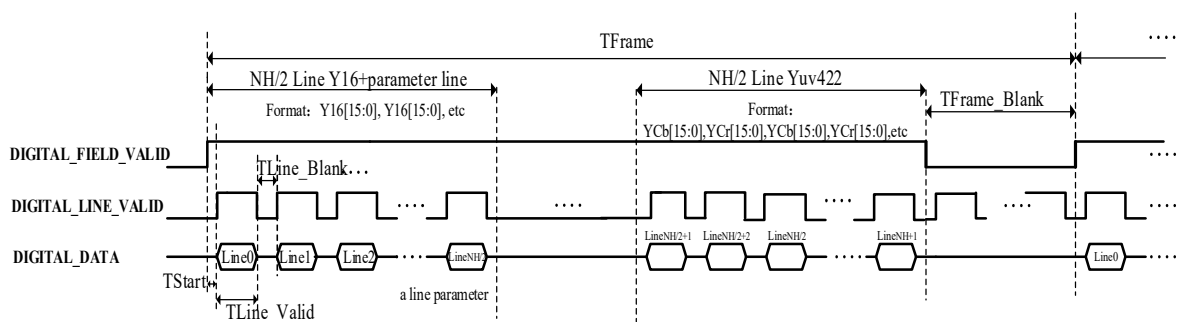


Fig.2-17 CMOS16, Y16+parameters+YUV422 frame timing

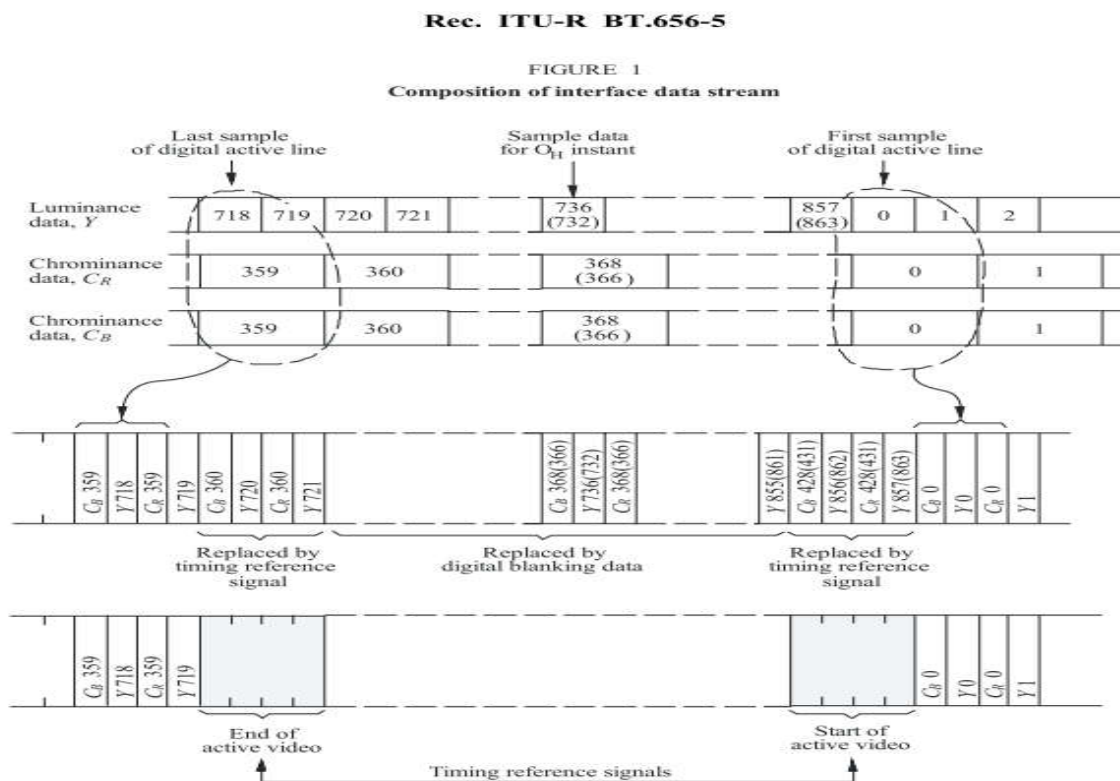
2.3.3 Description of BT.656 data

The BT.656 interface output data in standard BT.656 format. For details, see the ITU-R standard Recommendation ITU-R BT.656-5(12/2007), 8bits, interleaved.

- 1) Data format: Cb, Y, Cr, Y, Cb, Y, Cr, Y, etc;
- 2) Clock frequency:

System	resolution	Data clock	Remark
PAL	384x288	29.5MHz	
PAL	360x288	27MHz	
NTSC	360x240	27MHz	
NTSC	320x240	24.5454MHz	

- 3) Data timing: BT.656 format is to insert the line header and footer information into the common digital data stream, with the header information as the start of active video (SAV) and the footer information as the end of active video (EAV), as shown in Fig. 2-18, Table 2-10 and Table 2-11.



Note 1 – Sample identification numbers in parentheses are for 625-line systems where these differ from those for 525-line systems. (See also Recommendation ITU-R BT.803.)

0656-01

Fig.2-18 BT.656 data format

Table 2-10 Details of SAV and SEV in BT.656 format

Data bit number	First word (FF)	Second word (00)	Third word (00)	Fourth word (XY)
7(MSB)	1	0	0	1
6	1	0	0	F
5	1	0	0	V
4	1	0	0	H
3	1	0	0	P3
2	1	0	0	P2
1	1	0	0	P1
0	1	0	0	P0

Note:

F: 0 odd field; 1 even field

V: 0 field effective; 1 field blanking

H: 0 SAV; 1 EAV

P0, P1, P2, P3: Protection bits

Table 2-11 Protection bit in BT.656 format

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	Byte
MSB	F	V	H	P3	P2	P1	P0	
1	0	0	0	0	0	0	0	0x80
1	0	0	1	1	1	0	1	0x9D
1	0	1	0	1	0	1	1	0xAB
1	0	1	1	0	1	1	0	0xB6
1	1	0	0	0	1	1	1	0xC7
1	1	0	1	1	0	1	0	0xDA
1	1	1	0	1	1	0	0	0xEC
1	1	1	1	0	0	0	1	0xF1

2.3.4 Description of MIPI data

The MIPI uses the CSI-2 controller and the physical layer uses the TX terminal of DPHY. The basic information is as follows:

- 1) Data format: YUV422_8bit;
- 2) Clock frequency: 100MHz~300MHz;
- 3) The channel number supported: support 1lane or 2lane output.

3 Optional Accessories



tripod



hoop



lens



VPC board



Adapter +Video cable + Micro USB cable

3.1 VPC expansion board

The functions of the VPC board

- The functions of the VPC board are described below:
- Standard 5-PIN Micro USB interface:
- Power supply requirement of the Micro USB interface:
- Steady state current is 300mA@5V, and the transient starting current shall be 800mA@5V.
- Baud rate at serial port: 115200.
- MCX analog video interface, 75Ω characteristic impedance.
- Hot swap protection.

Application instruction for VPC board

VPC board has two external interfaces: analog video interface and Micro 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 Micro USB interface of the module and the other terminal connected to the USB interface of the computer. After the PC control software is installed on the computer, the connection between the module and the PC software can be realized through the USB cable. For the installation instructions of the PC control software, please refer to Section 4.1.

4 Basic operation of module and PC control software

4.1 Installation instructions of PC control software

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

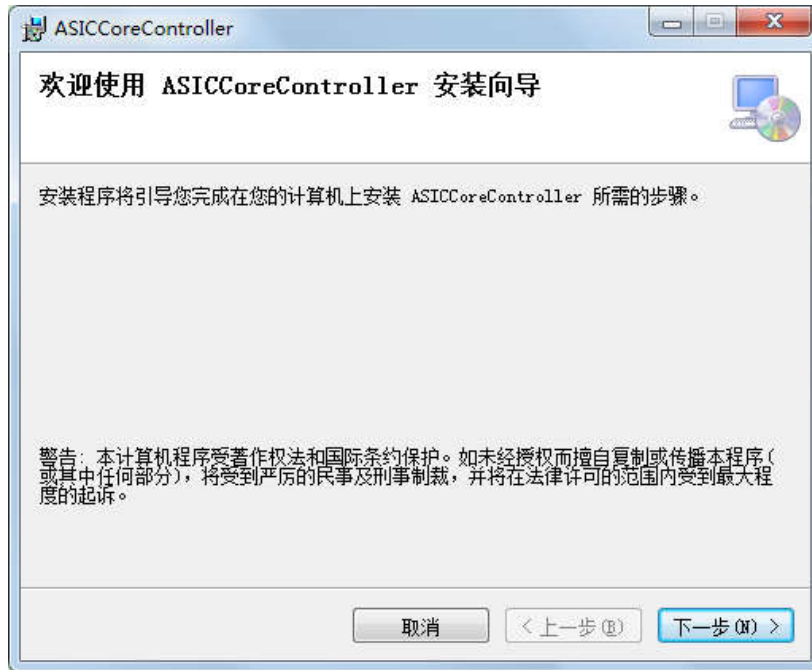


Figure 4-1 Software installation interface 1

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.

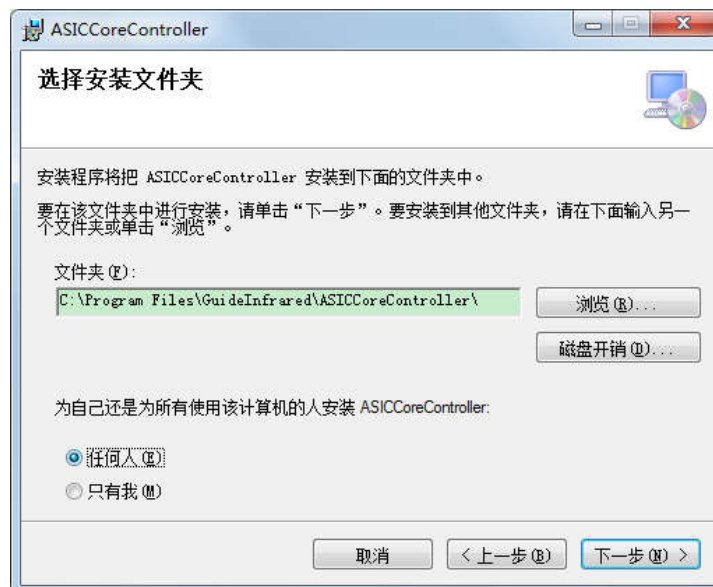


Figure 4-2 Software installation interface 2

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 Fig. 4-4.

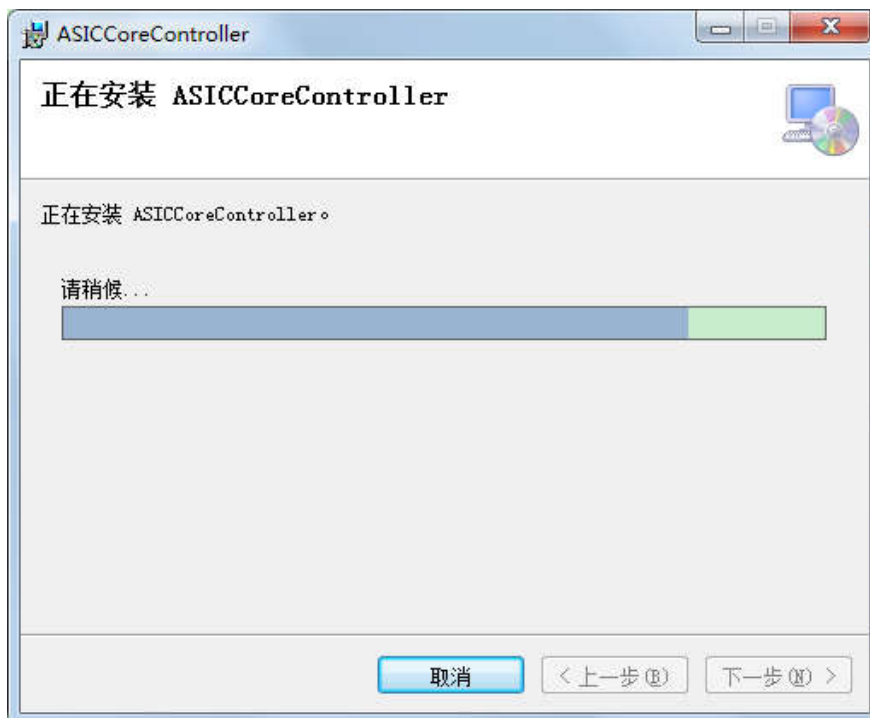


Figure 4-4 Software installation interface 4

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 4-6 Pop-up window for software installation complete

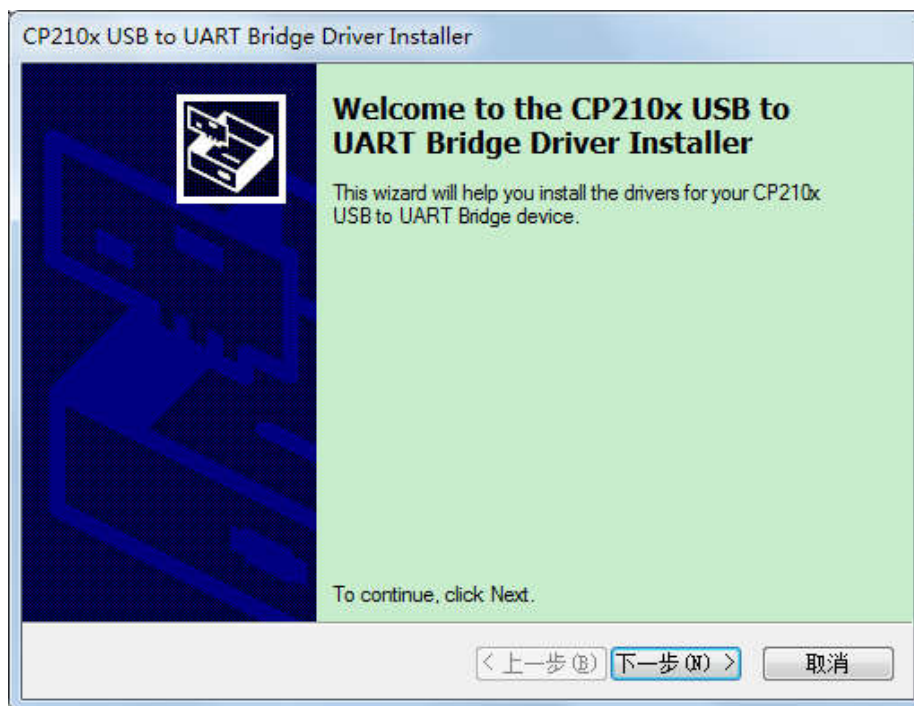


Figure 4-7 Pop-up window for USB driver installation

6. Click the button "Close" in Figure 4-6 to complete the module software installation, and then click the button "Next" in Figure 4-7 for USB driver installation, at which time, an agreement selection window as shown in Figure 4-8 will pop up.

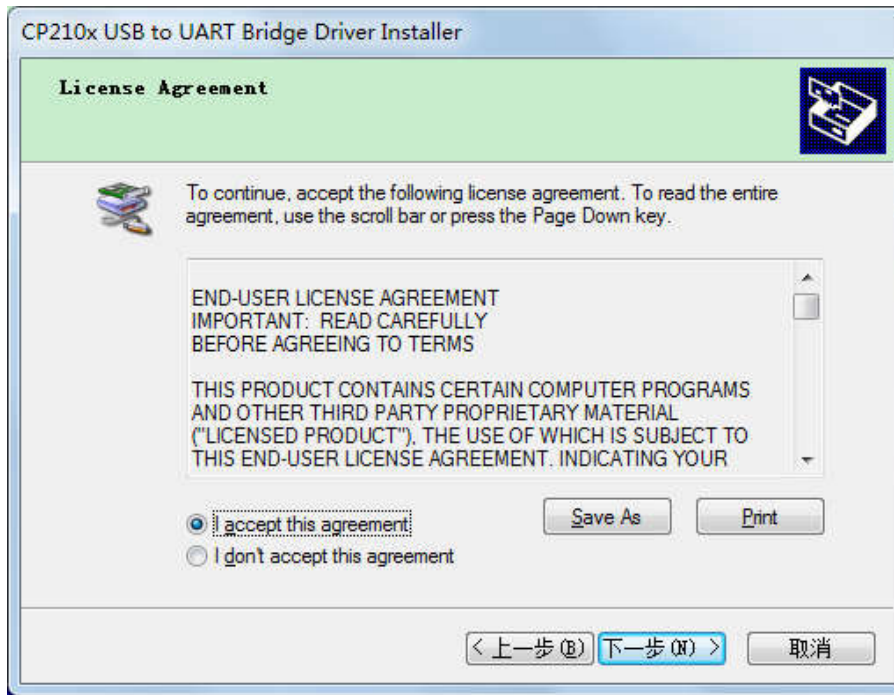


Figure 4-8 Agreement selection window

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. 4-9.

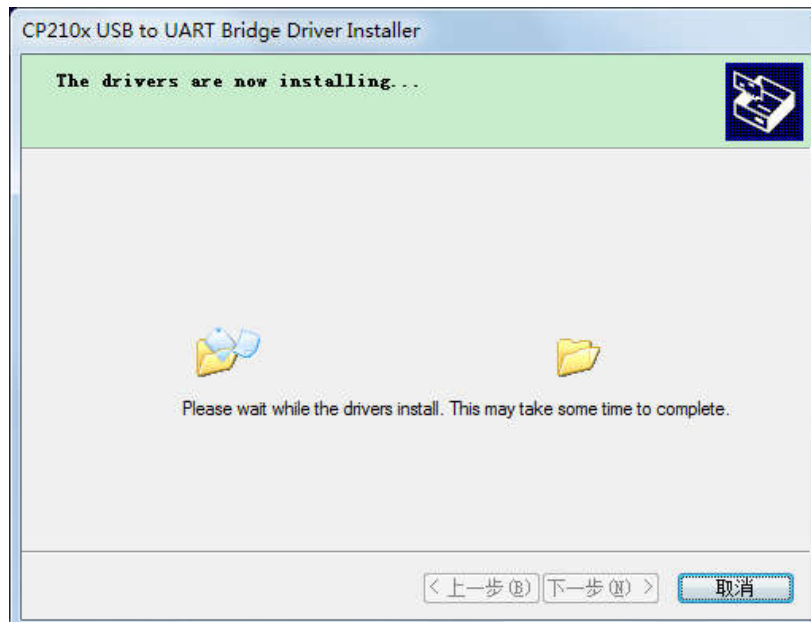


Figure 4-9 Installing window

9. Upon USB driver installation, an installation complete window as shown in Figure 4-10 will pop up.

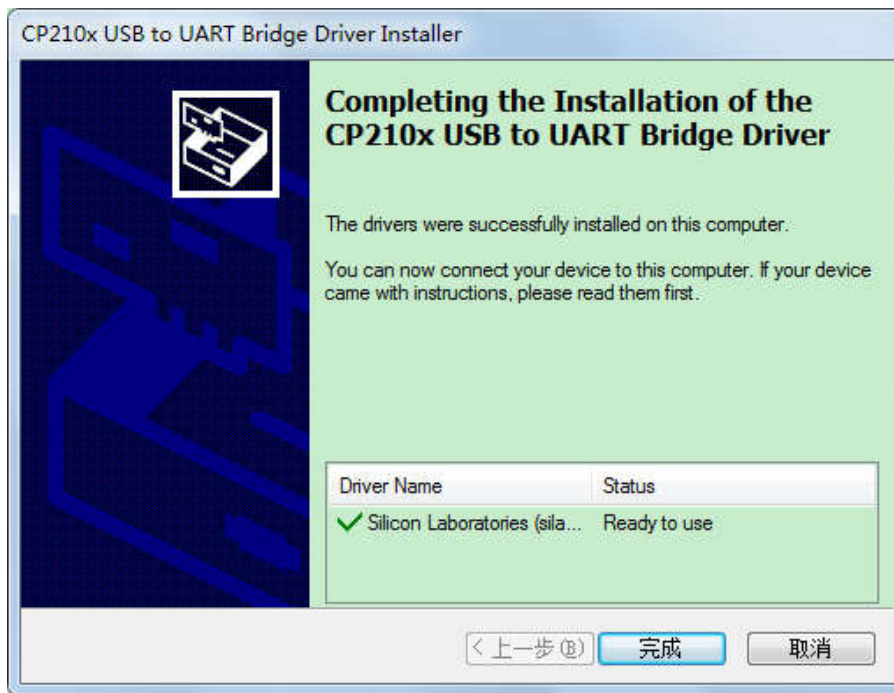



Figure 4-10 Pop-up window for USB installation complete

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 data wire.

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 4-11.

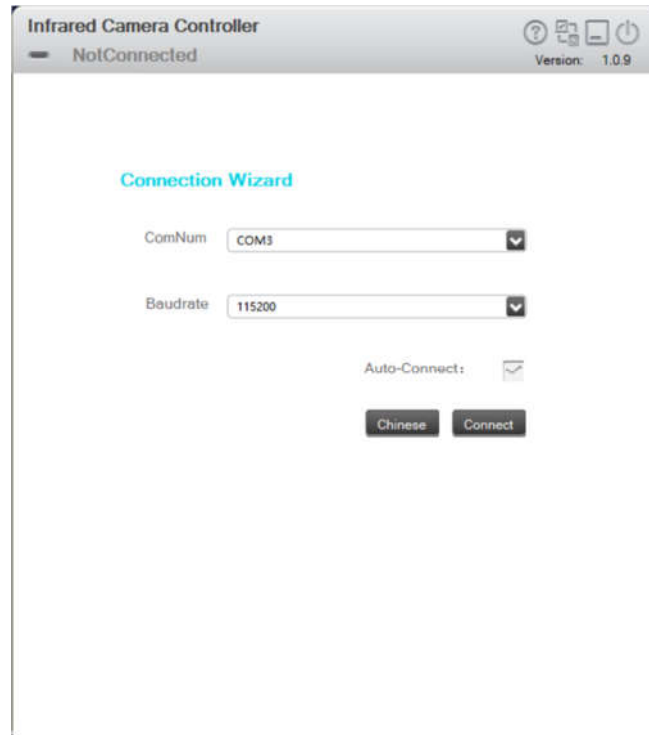








Figure 4-11 Connection wizard interface

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. Click the icon  to select the serial number and baud rate, and click the  to set whether automatic connection is used for the next software startup, as shown in figures 4-12, 4-13 and 4-14.

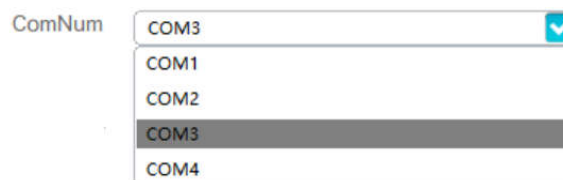


Figure 4-12 Selection of connection serial number

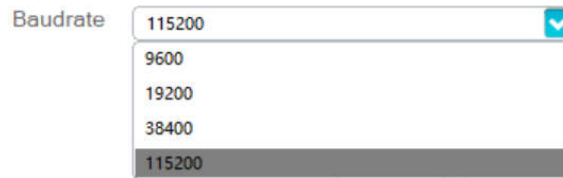


Figure 4-13 Selection of connection baud rate



Figure 4-14 Setting of automatic connection

If it is set as automatic connection, the module will not enter the connection wizard interface but directly enter the next interface at the next software startup, but the previous software language version is still kept unchanged.

5. Click "Chinese" to select the Chinese language version, or click "English" to select the English version, the connection wizard interface in English is shown in figure 15.

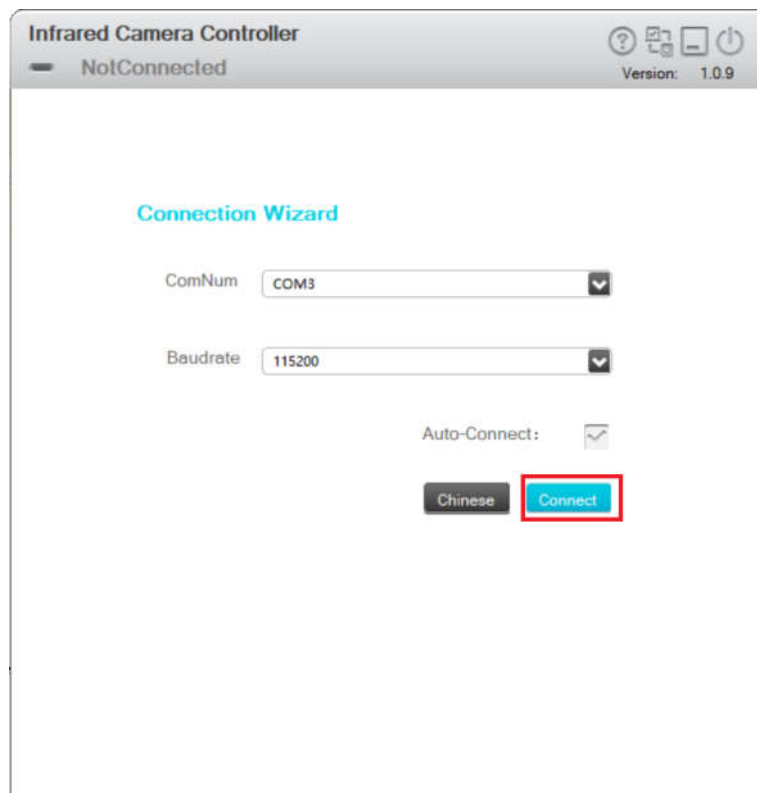



Figure 4-15 Connection wizard interface in English

6. Click the button "Connect" to connect the module, as shown in Figure 4-16. If the module is currently connected, click the icon  to switch to the connection wizard interface, and then click "Disconnect" to disconnect the module. The upper left corner shows the current connection status "DisConnect", as shown in Figure 4-17.



Connection Wizard

ComNum COM3

Baudrate 115200

Auto-Connect:

Connect Disconnect



Connection Wizard

ComNum COM3

Baudrate 115200

Auto-Connect:

Chinese Connect

Figure 4-16 Module connection

Figure 4-17 Module disconnection

4.3 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.

4.3.1 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 4-18.



Figure 4-18: 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.

4.3.2 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 4-19.

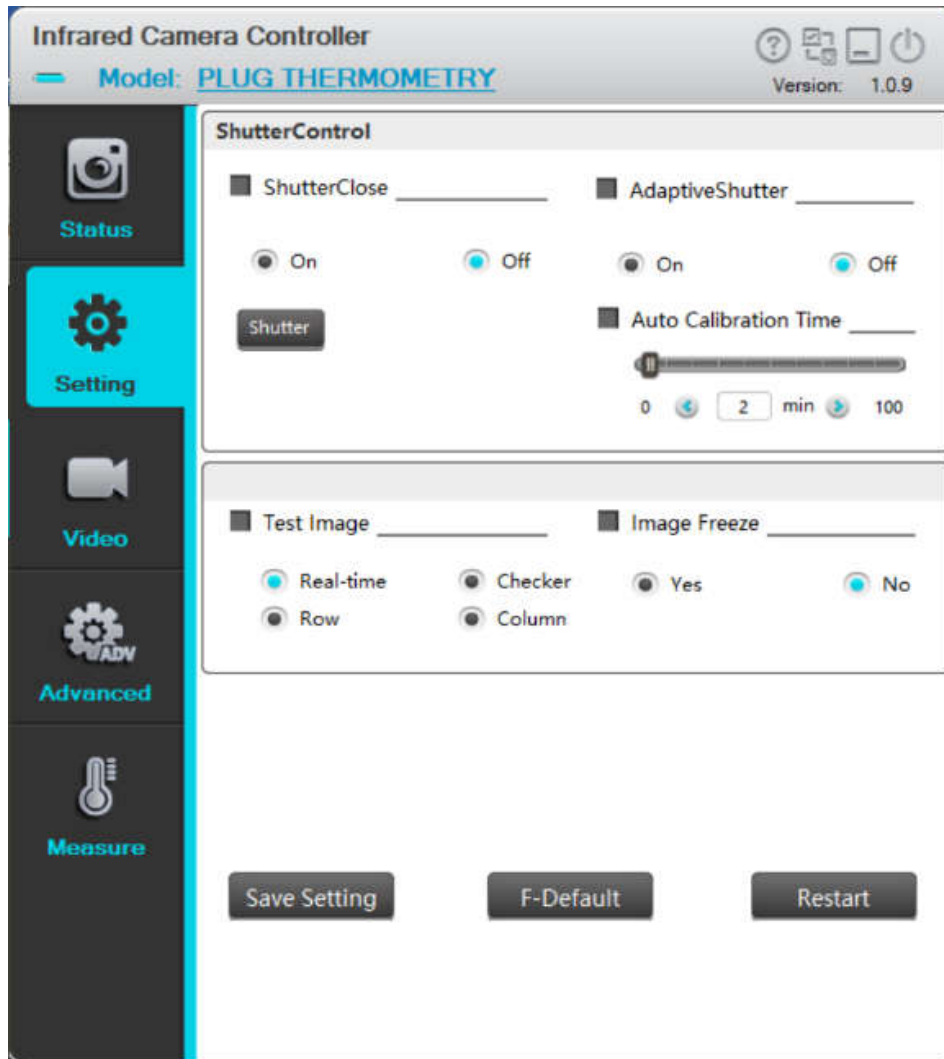


Figure 4-19 Module settings interface

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.

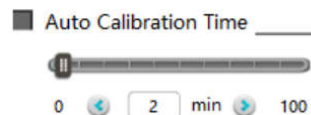


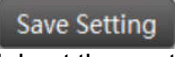
Image freeze: For the analog video scene of interest, you can select “Yes” to freeze the infrared scene image. Then the infrared image of the analog video output will not change as the scene does, allowing users to watch the scene of interest. You can choose “No” to unfreeze, to observe real-time changes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



Test screen: The module provides four models of image displays, including real-time image and three

test patterns; the test patterns include checkerboard pattern, horizontal scanning pattern and vertical scanning pattern.



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.

4.3.3 Video

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

4.3.3.1 Setting interface of analog video

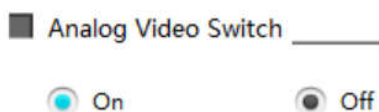
Click the video menu on the left side of the interface, and enter the analog video setting interface, as shown in Fig. 4-20.



Figure 4-20 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 four video systems: PAL (768*576) ,PAL (720*576)and NTSC (640*480), NTSC (720*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.

■ Analog Standard _____

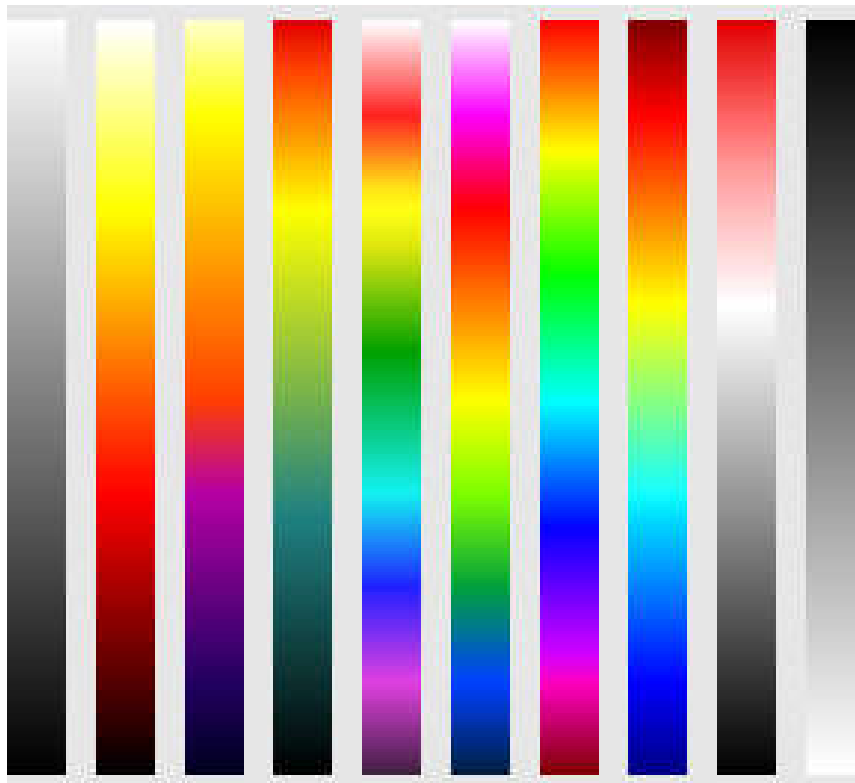
- PAL384x288
- NTSC320x240
- PAL360x288
- NTSC360x240

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 50Hz, 25Hz and 9Hz. If the module is working under NTSC system, the frame rate of the analog video can be set to 60Hz, 30Hz and 9Hz. The lower the frame rate is, the lower the frequency needed to discover analog video motion is.

■ Frame Rate _____

- 9
- 25
- 50

Polarity: 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.



■ Palette _____



Mirroring: As module can provide four image mirroring modes, and you can choose any one to change the direction of the image for digital and analog video.

■ Mirror _____



None: Keep the direction of outputting original image by the detector unchanged.

X: Mirror the original image horizontally. Map the pixels in the upper right corner of the detector to the upper left corner of the output video. When you need a horizontal mirroring scene or set the up and down direction of the module oppositely, you can choose the mirroring mode X.

Y: Mirror the original image vertically. Map the pixels in the upper left corner of the detector to the lower left corner of the output video. When you need a vertical mirror scene or set the up and down direction of the module oppositely, you can choose the mirroring mode Y.

XY: Mirror the original image horizontally and vertically at the same time. Map the pixels in the upper left corner of the detector to the lower left corner of the output video. When you need a diagonal mirroring scene, you can select the mirroring mode XY.

Zoom in: This infinite zoom function supports 1~8 times magnification configuration; the amplification precision is 0.125 times and the amplification factor is the 1/8 of setting value. For example, when the setting value is 8, the amplification factor is 1, which is the original image; if setting value is 64, the amplification factor is 8.

■ Zoom _____



The X/Y coordinates of the center point in zoom area: This option can set the coordinates of the center point in zoom area, so that the user can zoom in precisely on any area of interest in the analog video image.

■ Zoom Region CenterX _____



■ Zoom Region CenterY _____



Hotspot tracking: When setting to “on”, the hotspot in the full screen area of the infrared image can be tracked, marked with a white cross cursor. The color of the cross cursor can be customized.

Hot Track _____
 On Off

4.3.3.2 The digital video

Click digital video menu at the bottom of Fig. 4-20, and enter the digital video setting interface, as shown in Fig. 4-21.

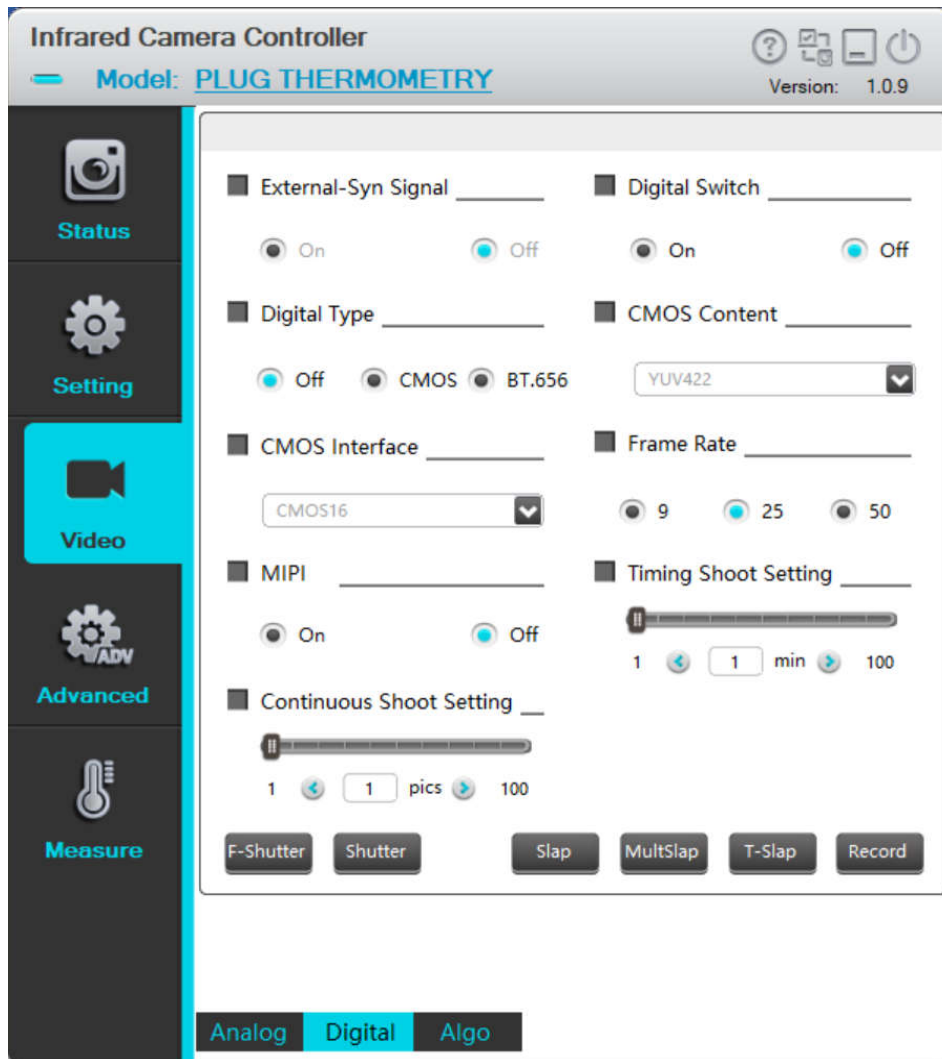


Figure 4-21 The setting interface of digital video

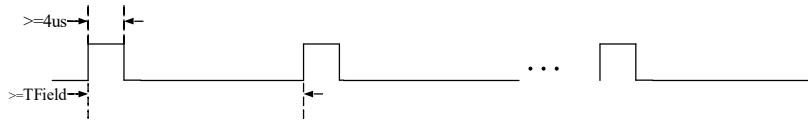
Digital video page is mainly used to achieve the related settings of digital video, such as external synchronization (slave mode) switch, digital port switch, digital port type, CMOS content, CMOS interface, digital frame rate and MIPI switch.

External synchronization: external synchronization (slave mode) switch of the module. (This function is unavailable by ICC PC control software, Please send related command by customer's platform.)

External-Syn Signal _____
 On Off

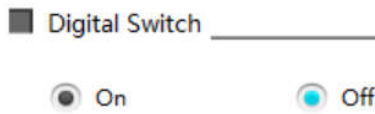
On: within 20 seconds after the module startup, input a synchronizing signal in fixed GPIO to make the module work in the slave mode. If the external sync source is still not detected after power-on for more than 20 seconds, the module will work in the internal sync mode and output the analog video normally.

The external sync input source must be a periodic signal with a period no smaller than the field period of the required IR. External synchronous mode employs high-level of external synchronizing signal to realize control, and the high level signal needs to be no smaller than $4\mu\text{s}$. The timing diagram is as follows:



Off: The module works in internal sync mode and outputs analog video normally.

Digital port switch: to set digital port switch. The switch can be set to "Off" when digital video is not needed. When digital video needs to be output, this switch needs to be set to "On" regardless of the format of the digital video. The definition of digital port can refer to the definition of digital port in Table 2-2.



If the digital video acquisition channel connection is effective, such as CameraLink channel or USB channel, after setting the digital port type, CMOS content and CMOS interface, select "On", a real-time video display window will be popped up, as shown in Fig. 4-22.

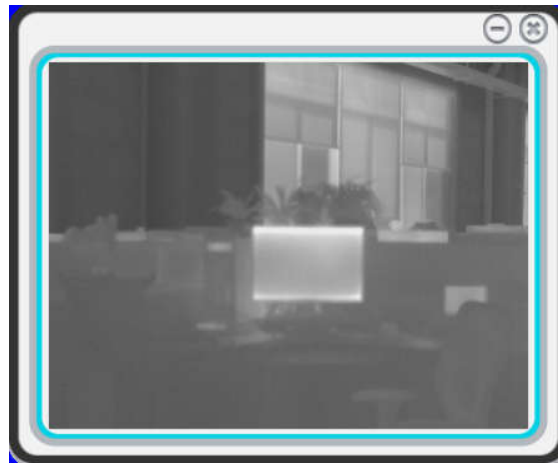
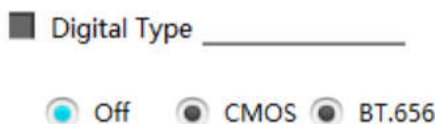


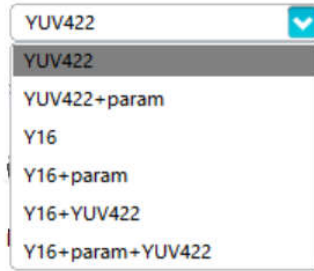
Fig. 4-22 Digital port real-time video

Digital port type: select the output format of digital parallel port, including CMOS and BT.656. If the digital port is needed to output BT.656, select "BT.656" in this item and set the digital port switch to "On". If choosing to output CMOS contents, you need to configure the CMOS content and CMOS interface options.



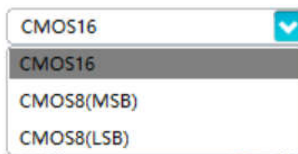
CMOS content: To select CMOS content. The CMOS content can only be configured when the digital port type option is "CMOS". CMOS content can be set as follows, and please refer to Section 2.3 for the digital port output timing. Each time you change the CMOS content, reopen the digital port for the changes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

■ CMOS Content _____



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.

■ CMOS Interface _____



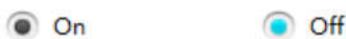
Frame rate: To set the digital video CMOS type output frame rate. If the module is working in PAL system, the frame rate of digital video can be set to 50Hz, 25Hz and 9Hz. If the module is working under NTSC system, the frame rate of the digital video can be set to 60Hz, 30Hz and 9Hz. The smaller the frame rate of the digital video, the smaller the frequency of the synchronized signal can be detected.

■ Frame Rate _____



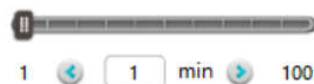
MIPI: To set the MIPI switch. When setting to “On”, the module will output standard MIPI timing from the fixed interface. The default setting is “Off”.

■ MIPI _____



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


■ Timing Shoot Setting _____




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

■ Continuous Shoot Setting _____



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

Shutter compensation: Click the button  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 **MultiSlap** 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 avi or raw, based on the digital port.

4.3.3.3 Algorithm

Click the algorithm menu at the bottom of Fig.4-20, and enter the algorithm setting interface 1, as shown in Fig. 4-23.

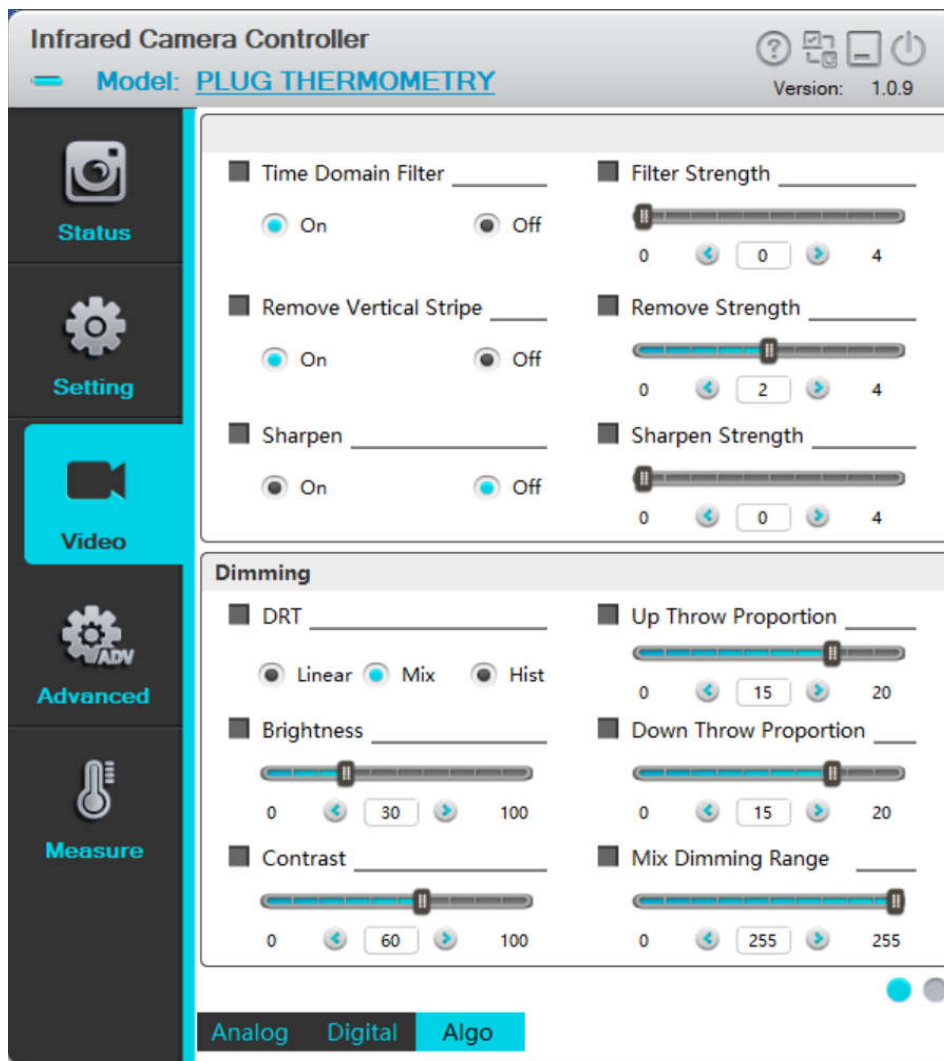


Fig. 4-23 The algorithm setting interface 1

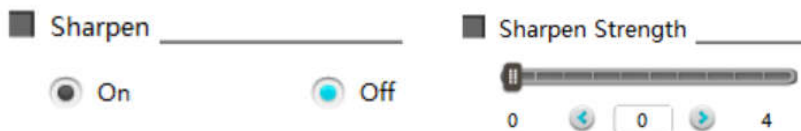
Time-domain filtering: Set the intensity of random noise in filtered infrared image sequences. The range of random noise filtering intensity is 0-4. The larger the value is, the greater the filtering degree is, the smoother the image will be, the more obvious the smear side effects will be.



Removal of vertical stripe: Remove non-uniformity noise at the column direction in the infrared image sequence. The vertical stripe intensity range is 0-4. The larger the value is, the better the effect of de-column non-uniformity is, but the more prominent the anti-vertical effect will be.



Sharpening: Enhance the sharpness of the image edge. The sharpening intensity range is 0-4; the greater the value is, the greater the sharpening strength is.



DRT dimming: Dynamic Range Transform. In order to render optimal image effects in different scenes, the module provides three dimming algorithms: linear dimming, histogram dimming and mixed dimming.



Linear dimming: Under the linear dimming mode, brightness and contrast are automatically optimized by linear transformation function based on image information statistics, to achieve dynamic range compression of image data. In this mode, brightness, contrast and proportion of throwing point can be adjusted.

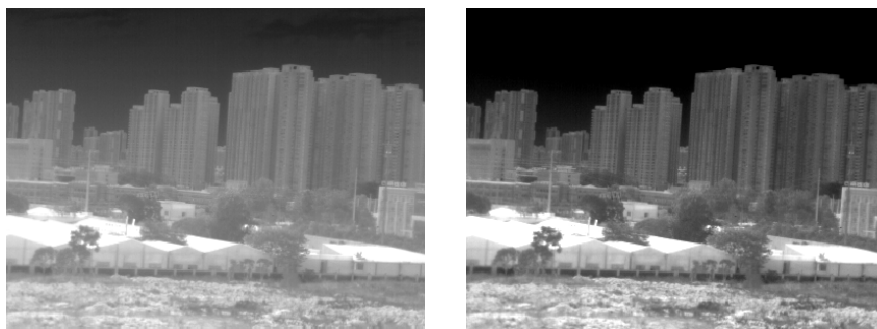


Fig. 4-23-1 Effect picture of linear dimming

(Default parameters: brightness 30, contrast 60, proportion of throwing point 5%)

Histogram dimming: Under the histogram dimming mode, the grayscale value of the image pixels is non-linearly mapped according to the cumulative probability of occurrence of the pixel gray level, to realize the dynamic range compression of the image data and achieve the dimming effect. In this mode,

the parameters cannot be adjusted.

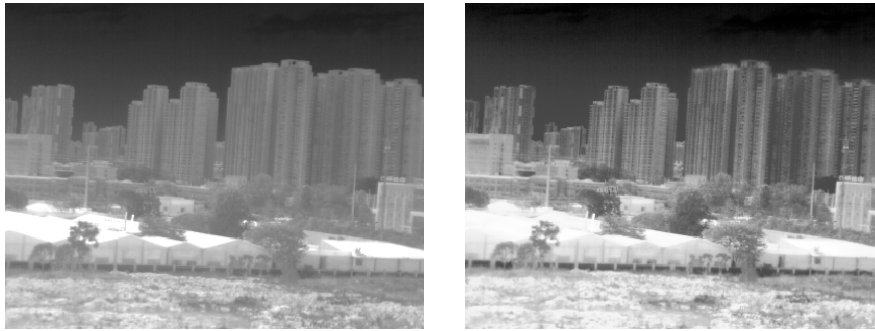


Fig. 4-23-2 Effect picture of histogram dimming

Mixed dimming: Under the mixed dimming mode, the weight of linear dimming and histogram dimming is adaptively adjusted according to the statistical information of the image, to automatically adjust the image performance based on different scenes. In this mode, the mapping range of mixed dimming is adjustable.

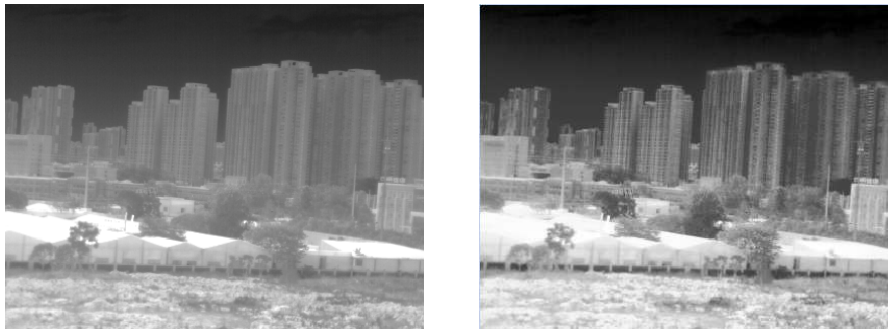
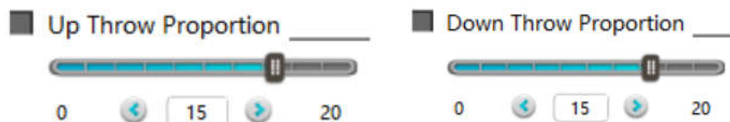


Fig. 4-23-3 Effect picture of mixed dimming

(Default parameter: mapping range of mixed dimming 255)

Proportion of upper throwing point: Under the linear dimming mode, the proportion of throwing point affects the mapping range of the original data and controls the ratio of pixels with saturated brightness in the image. The larger the proportion of upper throwing point is, the greater the contrast of the dimming result will be, and the more details lost due to image saturation.



Proportion of down throwing point: Under the linear dimming mode, the proportion of throwing point controls the mapping range of the original data and the ratio of bright saturated pixels in the image. The larger the proportion of down throwing point is, the greater the contrast of the dimming result will be, and the more details lost due to image saturation.

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.



The mapping range of mixed dimming: Under the mixed dimming mode, it reflects the overall grayscale value mapping range after image dimming. The larger the value is, the higher the overall brightness of the image will be.



Click the rightmost button at the right bottom of the algorithm setting menu to switch to the algorithm setting interface 2, as shown in Fig. 4-24.

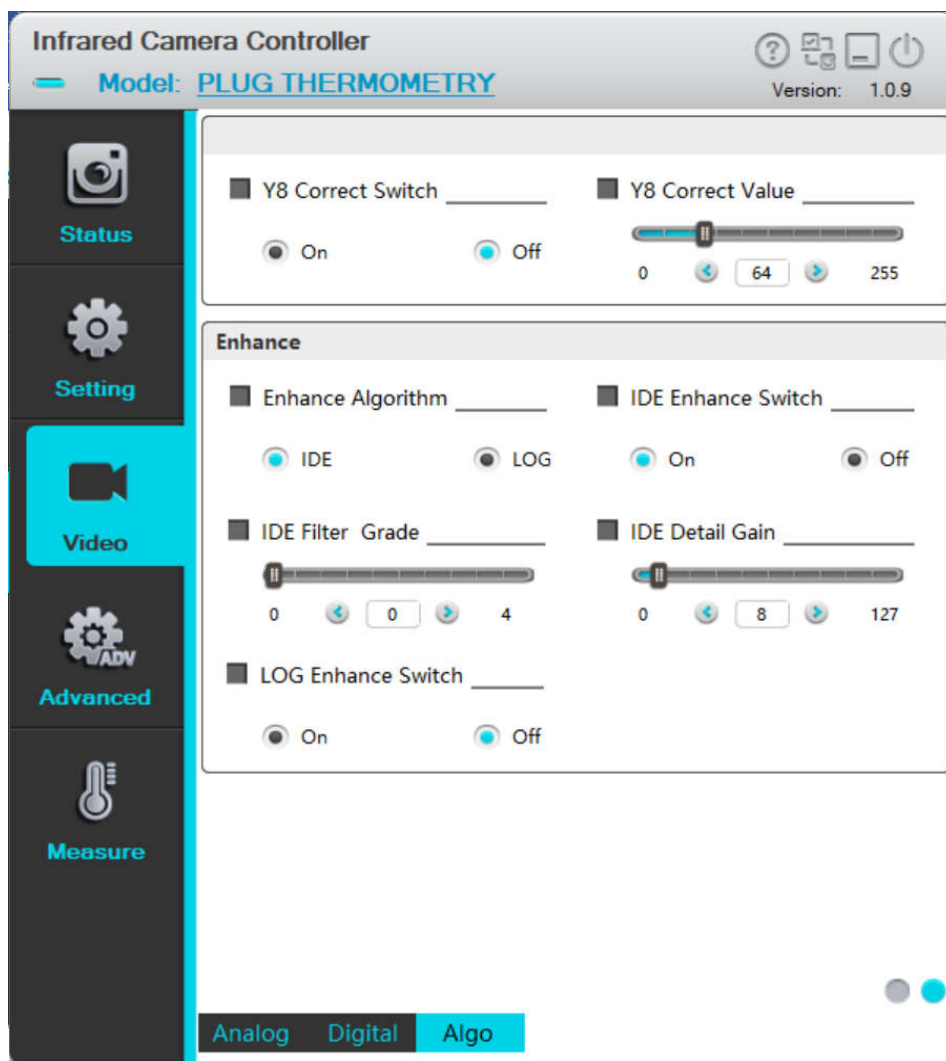


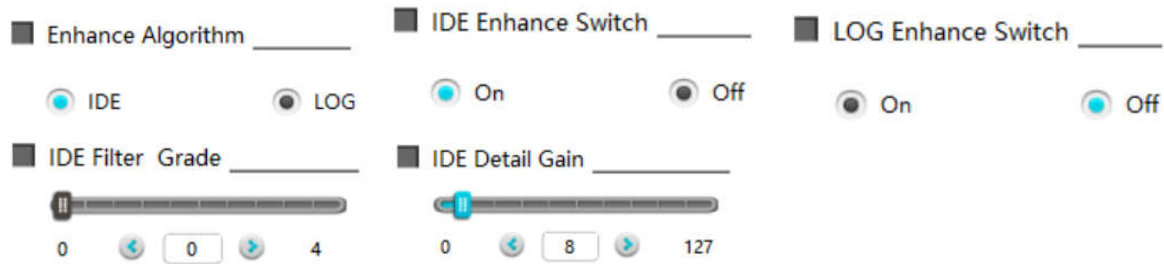
Fig. 4-24 Algorithm setting interface 2

Y8 Correction: Adjust the overall grayscale value of the image dimming; the Y8 Correction expectations: You can set the expected average brightness. The larger the parameter is, the brighter the image will be.



Enhance algorithm: enhance image detail information. It includes two algorithms, IDE (Image Detail Enhance) and LOG domain.

The two algorithms can be controlled by the on-off key separately. The algorithm parameter of LOG domain is not adjustable while the parameters of IDE algorithm can be adjusted. IDE filter level controls extract level of details, the larger value results in more details; IDE detail gain control the degree of detail enhancement at different level of details, and when the parameter is less than 16, it performs a smoothing effect. The larger the value is, the more obvious the image detail is enhanced.



a. Gain=8



b. Gain=16

Fig. 4-24-1 Different parameter comparison of detail gain

4.3.4 Advanced Application

This chapter focuses on the advanced application operation of the module, including focusing, defective pixel treatment, menu superposition and so on.

4.3.4.1 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 Fig. 4-25.

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



Fig. 4-25 Advanced application interface

(1) Electric DC focusing lens

On the focusing interface, the electric DC focusing lens is mainly configured, including selection of lens type and parameters required to be set for the motor in each lens: manual focusing speed, statistic frame number of automatic focusing, Max automatic focusing speed and Min automatic focusing speed. These parameters are set only when the user needs to configure the electric DC focusing lens himself. When **the motor driven board** is used, the focusing can be controlled via near, far and automatic focusing keys.

Lens type: if the module needs to support the electric DC focusing lens with various focal lengths, the lens type shall be selected according to the lens and the parameters of motor in the lens shall be set.

■ Lens Type _____

25mm
25mm
40mm
75mm
100mm
150mm

Manual focusing speed: After the user configures the electric DC focusing lens himself, this parameter shall be set firstly to test the min speed allowing the normal rotation of motor.

■ Manual Focus Speed _____

1 10 10

Automatic focusing parameter: if automatic focusing speed is required after the user configures the electric DC focusing lens, the following parameters shall be set: statistic frame number of automatic focusing, Max automatic focusing speed and Min automatic focusing speed. Please refer to Operating Instructions of Automatic Focusing Test for further details.

■ Auto Focus Frame _____

1 15 50

■ Auto Focus Speed Max _____

1 10 10

■ Auto Focus Speed Min _____

1 6 10

Focusing: in case of electric focusing lens, the “Near focus” or “Far focus” key can be long pressed to drive the motor run and perform electric focusing. Focusing will stop when the key is up. Image can be focused automatically to clear by pressing “Automatic focusing” key.



(2) Updating program

Select ". Bin "file, upgrade as shown below.



Cautions

1. Don't switch off during the updating program process until the end of the upgrade, regardless of successful or unsuccessful, as shown in Fig. 4-25-3;
2. If the updating doesn't work, please try again.



Fig. 4-25-1 input of updating

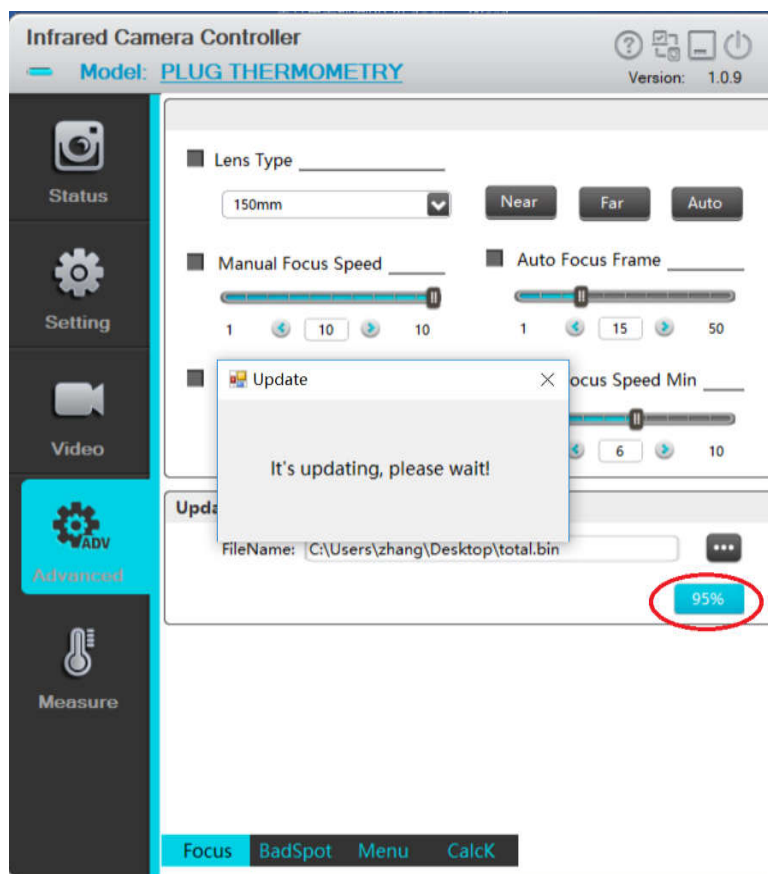


Fig. 4-25-2 it's updating, please wait!

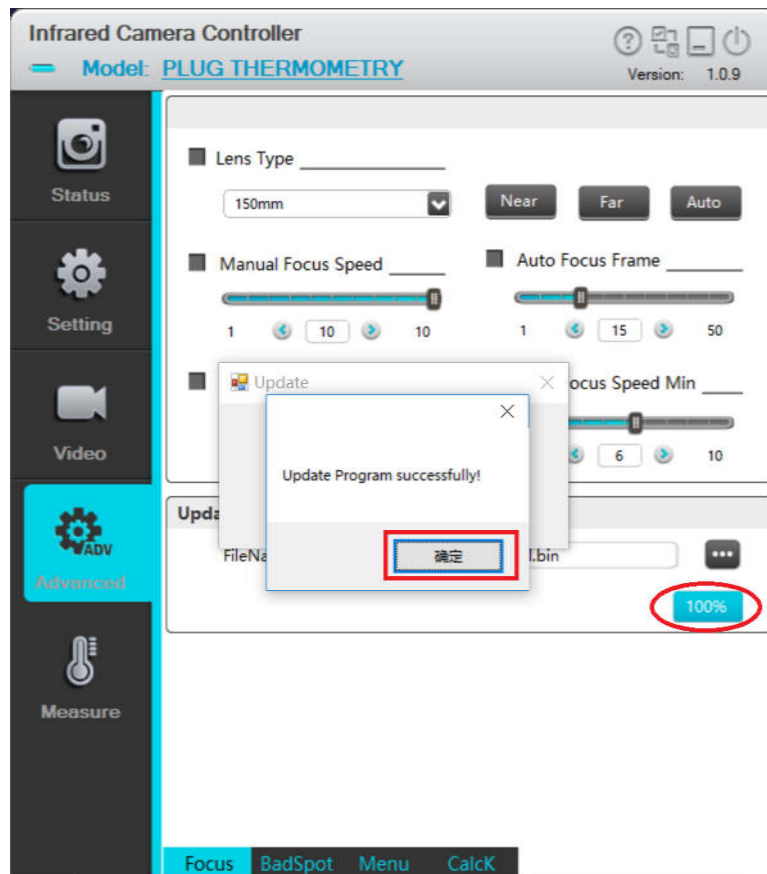


Fig. 4-25-3 the end of updating program

4.3.4.2 Defective pixel correction interface

Click the “Defective pixel” menu on the interface as shown in Fig. 4-25, and enter the defective pixel correction interface of advanced application as shown in Fig. 4-26.

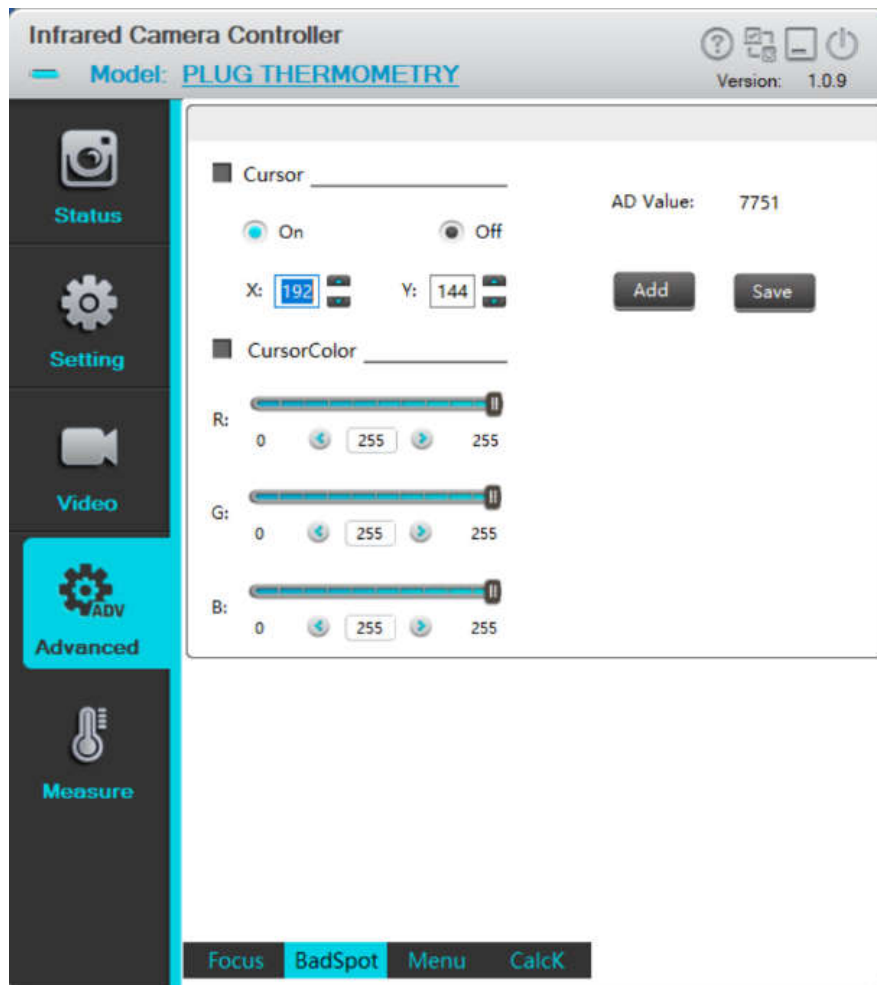
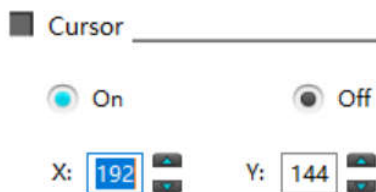


Fig. 4-26 Defective pixel correction interface

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.

AD Value: 7751

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.

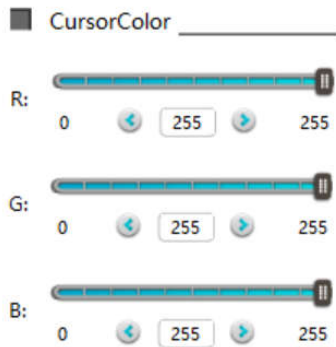


Adding defective pixels: For the defective pixels of the detector pixel, you can move the cursor to a defective pixel, and click the "Add Defective Pixel" button to replace the selected defective pixel with a

new pixel to improve image quality.

Saving defective pixels: After addition and replacement of the defective pixels, 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.

Cursor color: Customizable.



4.3.4.3 Menu function interface

Click the “Menu function” menu on the interface as shown in Fig. 4-25, and enter the menu function interface of advanced application as shown in Fig. 4-27.

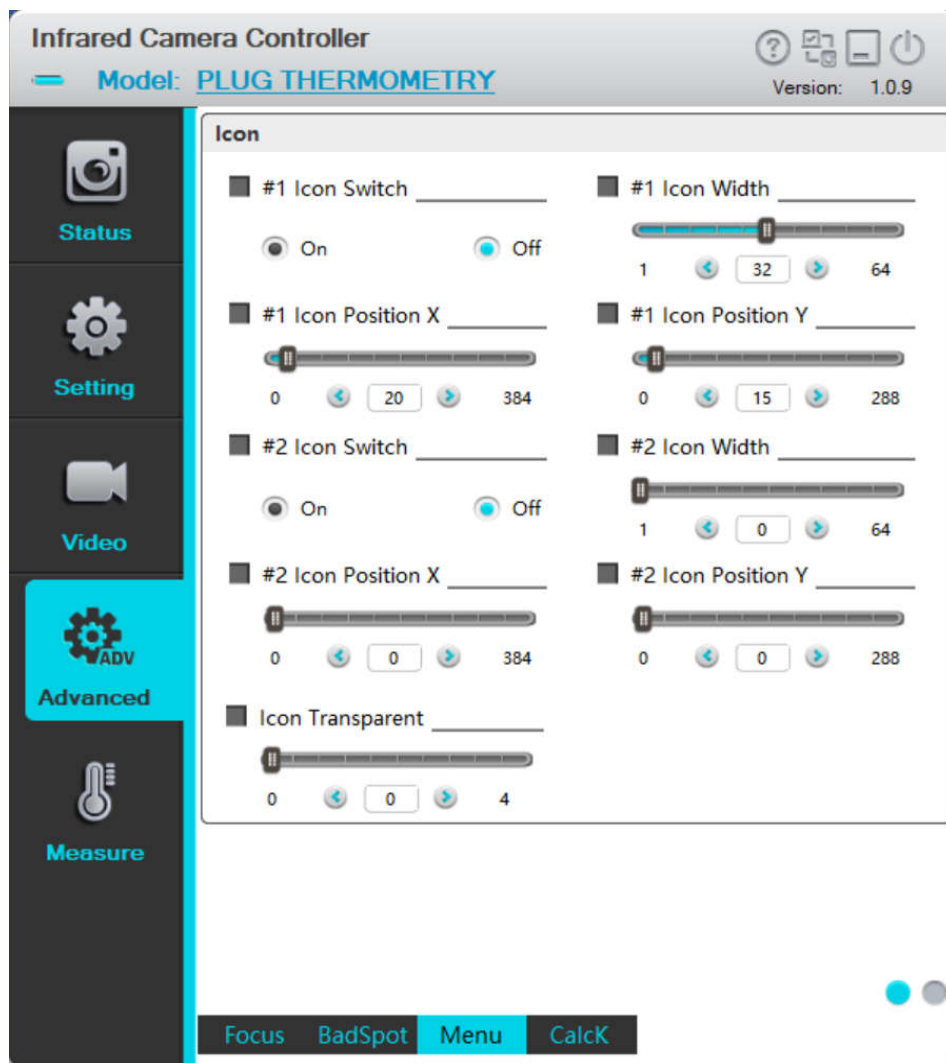


Fig. 4-27 Menu function interface 1

The menu function interface 1 mainly contains icon, menu bar, layer and half pixel cursor.

The icon function includes the following settings: icon switch, icon width, and coordinate X/Y of icon display location.

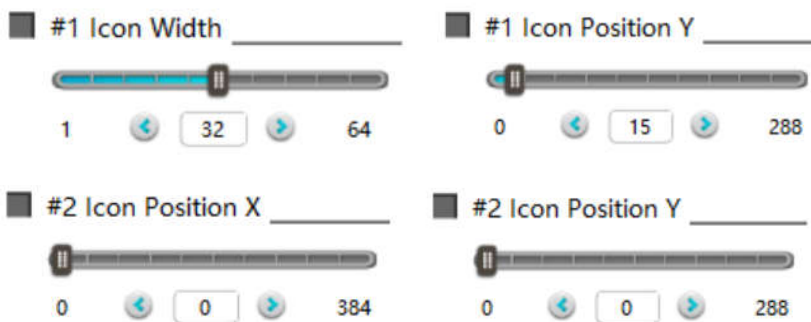
Small icon switch: if the icon is required to be displayed, it is necessary to import icon content into the module and set the icon width and the coordinate X/Y of icon. Upon this, turn the icon switch on, and the icon style will be displayed at X/Y location on the analog video image. The icon style can be customized.



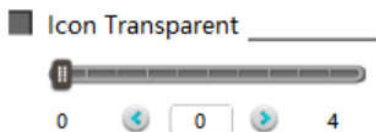
Small icon width: the to-be-displayed icon must be square, its width is settable and the maximum size is 64*64. The width setting must be matched with the imported icon size.



Small icon location X/Y: setting of the to-be-displayed icon location. The location can be moved within the analog image through setting.



Small icon transparency: Upon the setting of different levels of transparency, it can be observed that the background color of small icon become transparent gradually until it is displayed as IR image.



Click the right button in at the right bottom of setting interface of menu function page, switching to the menu function interface 2 as shown in Fig. 4-28.

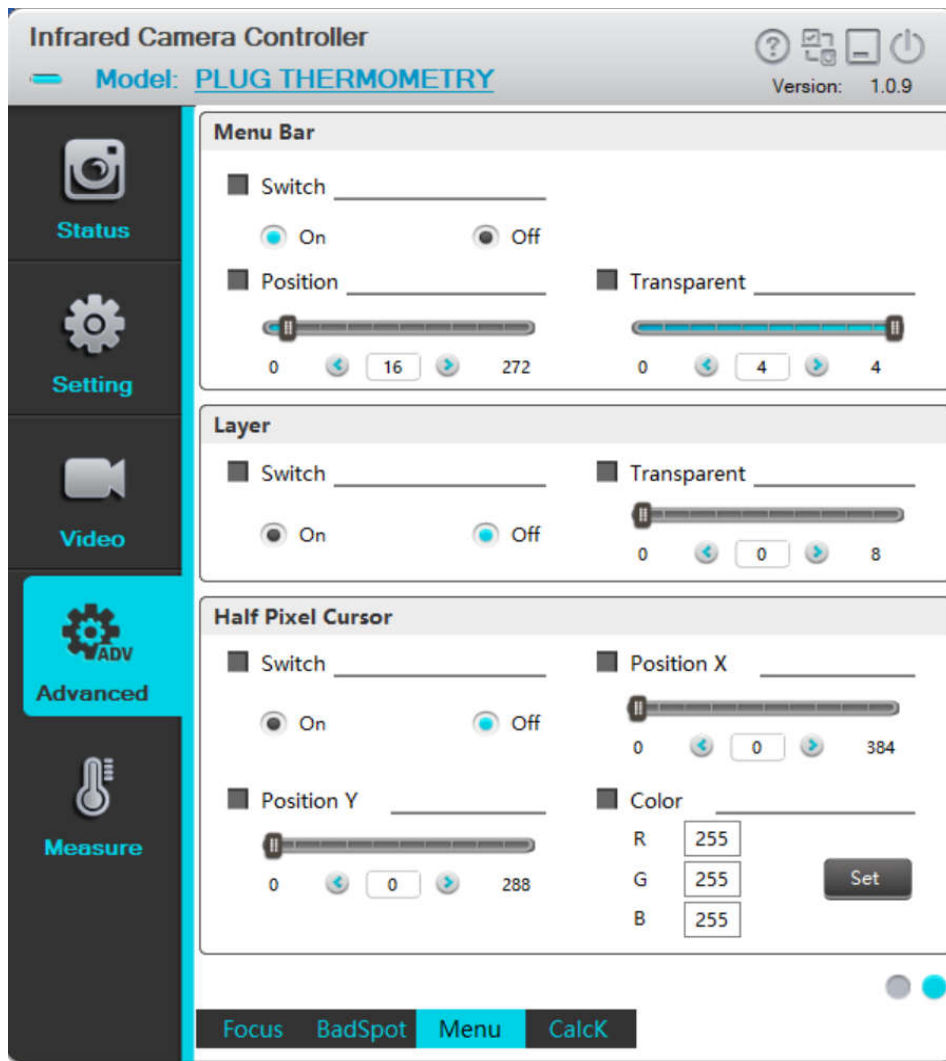


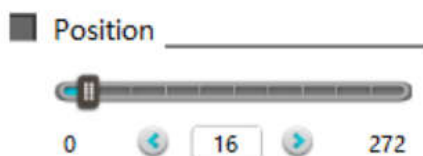
Fig. 4-28 Menu function interface 2

Menu bar switch, location and transparency can be set on the menu function interface 2.

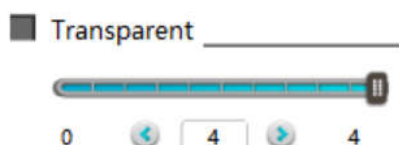
Switch: If the menu needs to be displayed, menu contents shall be designed in advance. Set the menu display as “On”, and the menu will be displayed on the analog video image.



Location: setting of the display location of the menu bar. The location can be set by moving only in the coordinate Y direction.



Transparency: Transparency can be set if IR image is required to be displayed on the menu background.



Layer: Customizable.

Half pixel: Customizable.

4.3.4.4 Two point Non-uniformity calibration

Click the “CalcK function” menu on the interface as shown in Fig. 4-28, and enter the K value calculation function interface of advanced application as shown in Fig. 4-29.

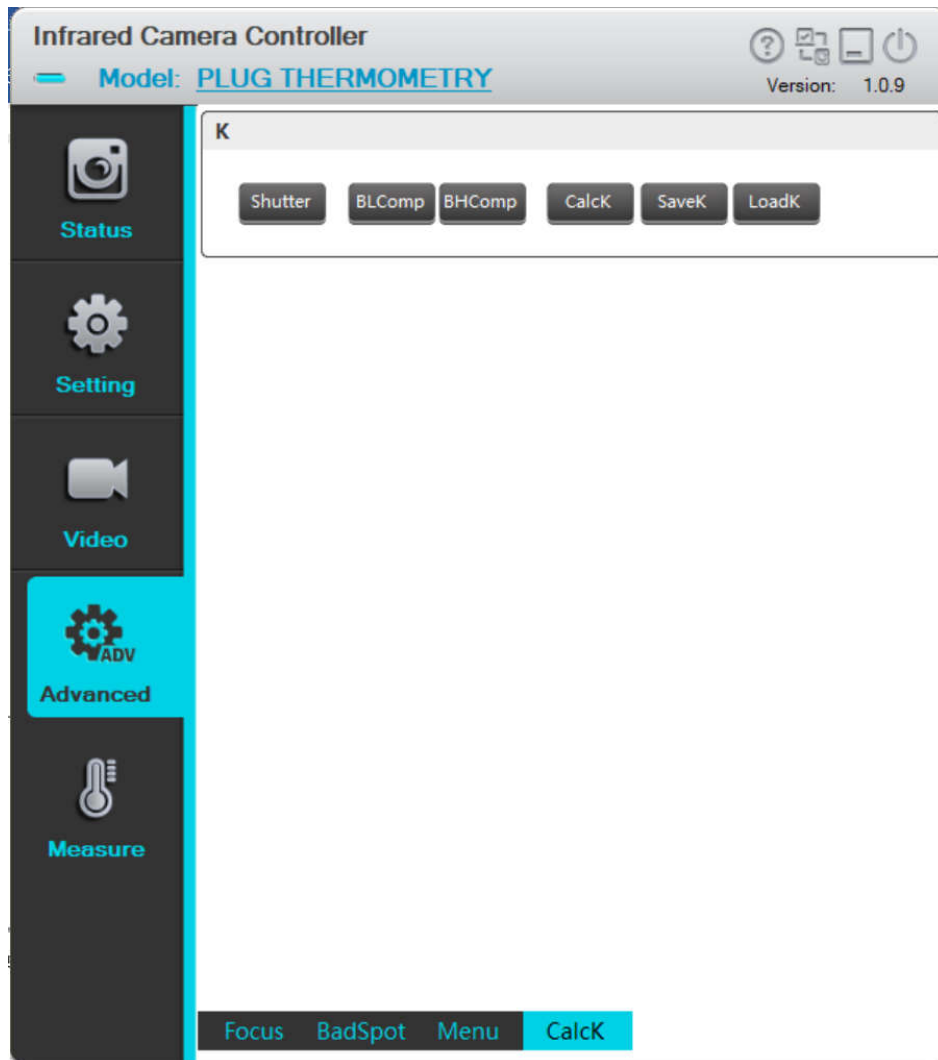


Fig. 4-29 K value calculation interface

For the use of K value calculation page, please refer to two point Non-uniformity calibration(NUC) guidance.

4.3.5 Thermography Application

This chapter mainly describes the distance, emissivity, temperature measurement range, temperature show and temperature correction settings, and introduces its function in detail.

4.3.5.1 Parameters setting interface

Click thermography application menu at the left of interface, and enter the parameters setting interface of thermography application, as shown in Fig.4-30

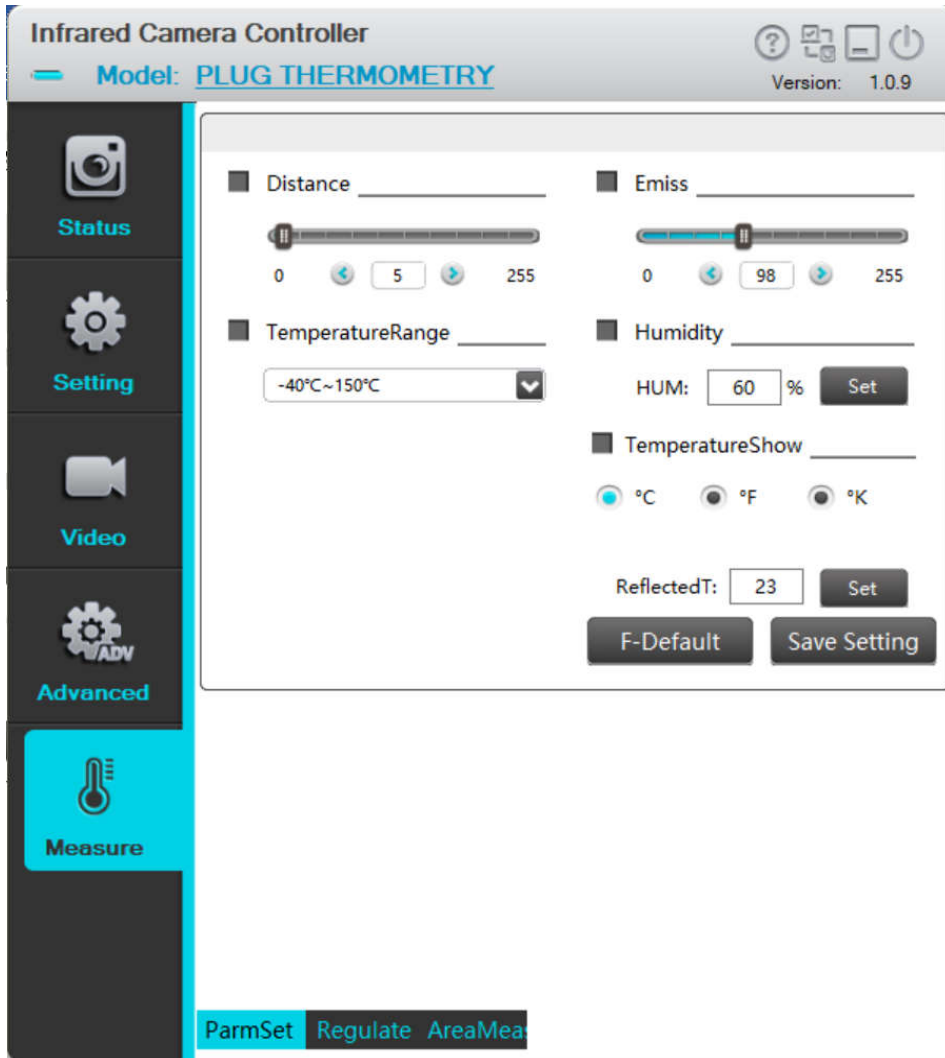
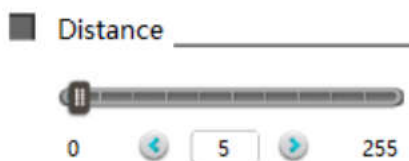


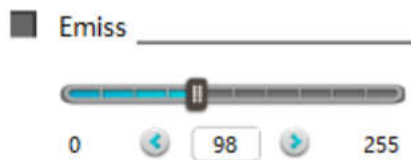
Fig.4-30 thermography application interface

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.

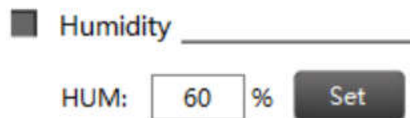
Distance : customizable from 0 to 100, the typical distance is 5m.



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



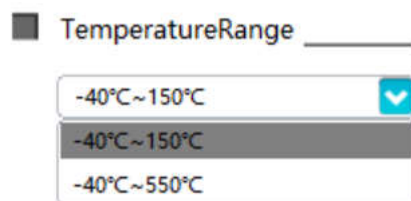
Humidity: customizable from 0~100%, the typical data is 80%.



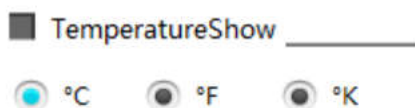
Temperature measurement range: set the range of measurable target temperature of the current device, two ranges are optional.

One temperature measurement range is $-40^{\circ}\text{C}\sim 150^{\circ}\text{C}$;

The other range is $-40^{\circ}\text{C}\sim 550^{\circ}\text{C}$ 。



Temperature Show: switch of temperature units, the degree Celsius、 degree Fahrenheit and degree Kelvin can be freely switched between each other.



Factory reset: Press the button "Factory Reset" **F-Default** to restore module's all configurations to the factory defaults.

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

4.3.5.2 Blackbody correction interface

Click the “Regulate” (Blackbody correction) menu on the interface as shown in Fig.4-30, and enter the blackbody correction interface of thermography application as shown in Fig.4-31.



Fig.4-31 blackbody correction interface

For the use of black body correction page, please refer to the secondary calibration guidance.

4.3.5.3 Area measurement interface

Tap button “AreaMeasurement” menu on the interface as shown in Fig.4-31, and enter the area measurement interface of thermography application as shown in Fig.4-32.

When the area temperature measurement function is off, the screen displays the full screen maximum value, minimum value, average value and cross cursor temperature.

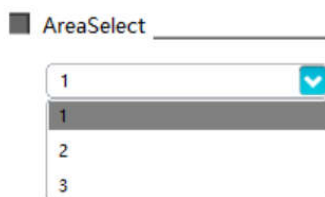
At present, two analysis objects is available, such as rectangle region and cross cursor spot objects. Also, you may select to display the maximum, minimum and average temperatures as well as to cursor temperature the display. The rectangle analysis object is up to three, the cursor spot analysis object is one.



Fig.4-32 Area measurement interface

Rectangle analysis object

1. The rectangle analysis object is up to three.



2. The area temperature can be unlimited, but the area region is up to 255x255. The default starting point coordinates of the three regions are (0,0) and the size is 255x255.

When the area temperature switch is turned on, the area and its starting coordinates, width and height

are the areas displayed in the area selection bar.

Area measurement operation can utilize the following buttons.



3. Take the second area region as an example as shown in Fig.4-33.

Make sure the switches of area measurement and area two open.

After selecting the area number 2, set the starting coordinates and width and height of the area. After clicking Settings, the area setting is completed.

After the regional setting is completed, the switch of area 2 can be opened, temperature measurement of area 2 is available.

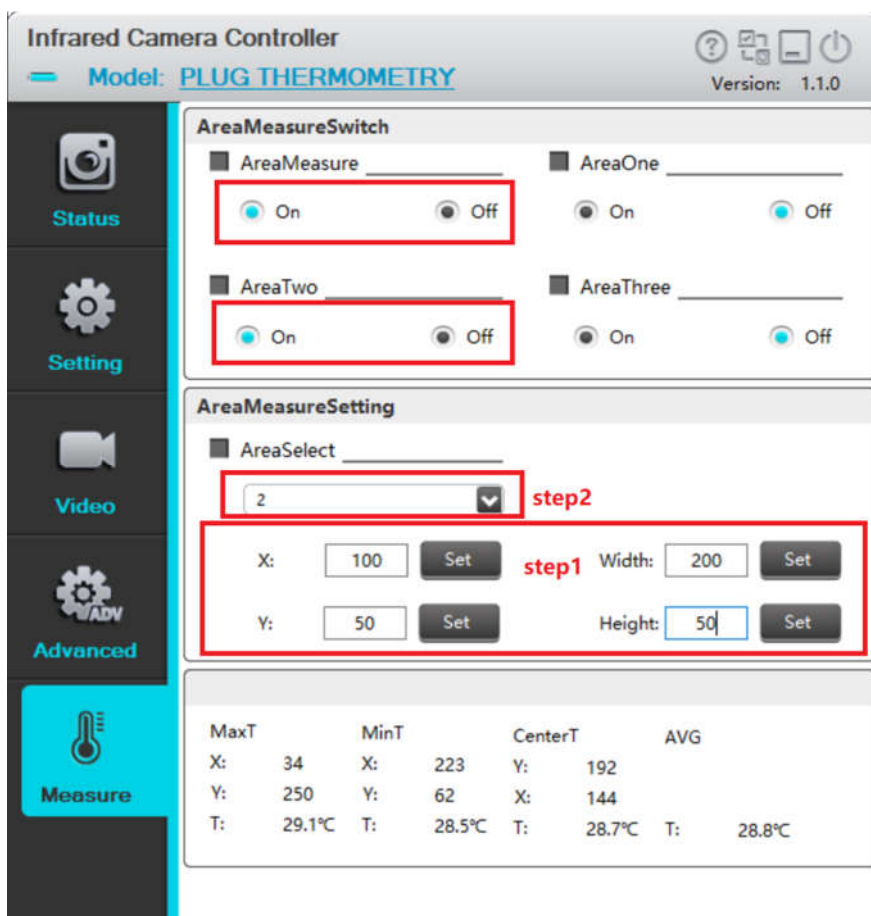


Fig.4-33 Area measurement setting

Note:

1. Three regions are independently controlled, and can't be measured at the same time.
2. The currently selected temperature measurement area is white, indicating that the temperature measurement is valid. The unselected area is black and the temperature is not measured.
3. If you want to change the position of the region, you must send the area selected command once after resetting the starting coordinates of the area and the width and height.
4. Any point analysis object only supports one, and the temperature data of the point is obtained by modifying the position of the cursor.


The cursor can be moved by adjusting the coordinates X and Y, or moved continuously via the arrow keys on keyboard. For detail, please refer to the section "4.3.4.2 Defective pixel correction interface"

5 Frequently asked questions (FAQ)

Question 1: Prepare for demonstration?



Question 2: How to choose the correct serial number to connect?

Answer: the solution is: 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.

ComNum	COM3	Baudrate	115200
	COM1		9600
	COM2		19200
	COM3		38400
	COM4		115200

Question 3: How to use digital port format?

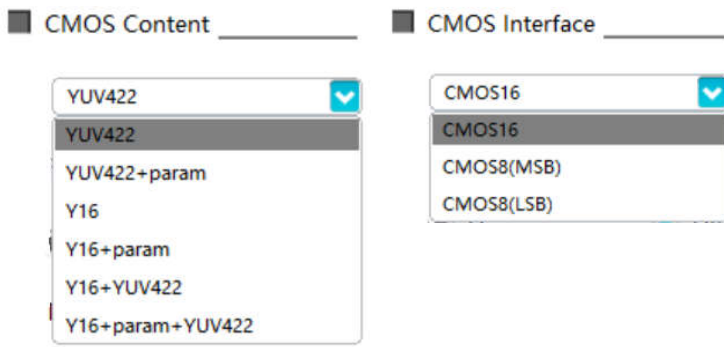
Answer:

A. There are two kinds of digital video format can be chosen, CMOS or BT.656.

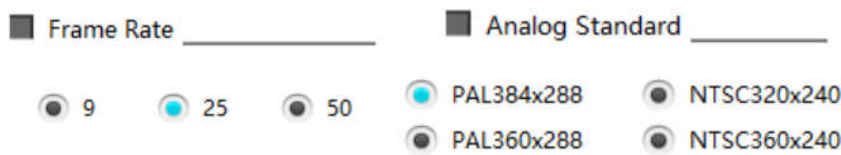
Digital Type _____

Off CMOS BT.656

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



C. If the BT.656 format is selected, the core will automatically switch to the BT656 format data matching the corresponding frame frequency and video format;



More BT.656 information can refer to the section “2.3.3 Description of BT.656 data”.

Question 4: Why is no image displayed when clicking “Video” menu?

Answer: possible reasons are:

- A. The video capture card is installed incorrectly or disconnected with the module.
- B. The video mode is not selected from the “Setting” menu.

Solution: Check that the video capture card is installed correctly and normatively, and then select the video mode from the "Setting" menu.

Question 5: After the previous question, if the video capture card is installed, why real-time video display is unavailable when interface CMOS8 (MSB) or CMOS8 (LSB) is selected?

Answer: Except for interface CMOS16, the other two interfaces do not support real time video display.

6 Specification of Serial Communication Protocol

6.1 Overview

This chapter describes the applicable scope and format of serial protocol of PLUG 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 5-1.

Table 5-1 Serial port data format

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

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. 5-1.

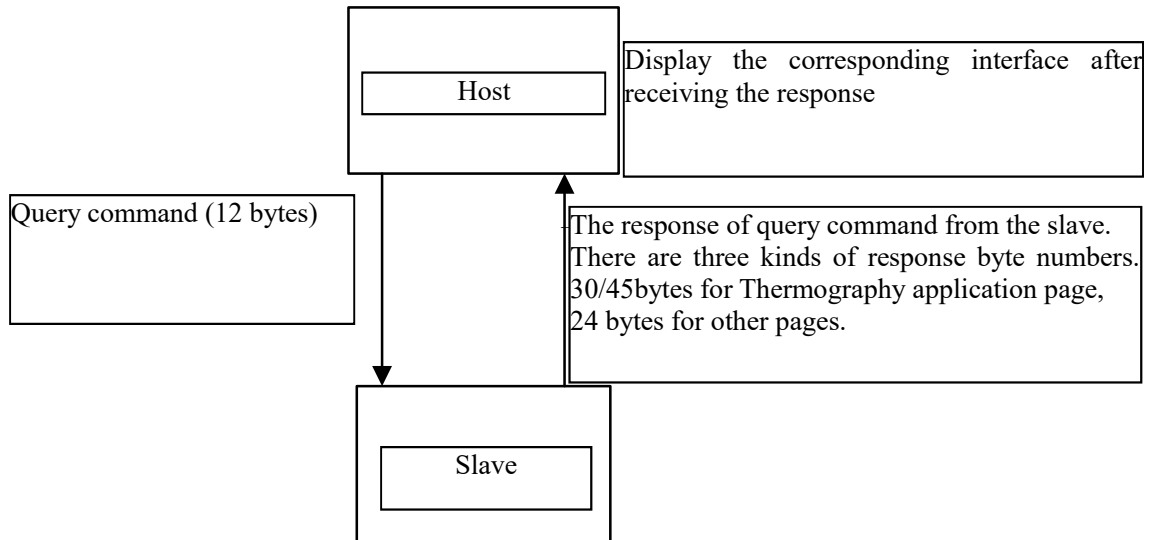


Fig. 5-1 The working process

6.2.1 Downlink protocol

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

Table. 5-2 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 5-3.

Table 5-3 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	Expert page	
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	0xFF	XOR checkout	
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 5-4.

Table 5-4 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 (0 represents that the shutter won't open since then)	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-time image	55 AA 07 01 00 03 00 00 00 00 05 F0
		00 00 00 01	Checker board 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	Line 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	00 00 00 01	Setting	55 AA 07 01 00 06 00 00 00 01 01 F0
the rising of temperature calibration	0x07	00 00 00 00	Switch off	55 AA 07 01 00 07 00 00 00 00 01 F0
		00 00 00 01	Switch on	55 AA 07 01 00 07 00 00 00 01 00 F0
Shutter control option	0x08	00 00 00 00	Auto	55 AA 07 01 00 08 00 00 00 00 0E F0

		00 00 00 01	manual	55 AA 07 01 00 08 00 00 00 01 0F F0
Shutter manual control command	0x08	00 00 0000	Shutter close on	55 AA 07 A0 02 08 00 0000 00 AD F0
		00 00 0001	Shutter open	55 AA 07 A0 02 08 00 0000 01 AC F0

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 5-5 for details.

Table 5-5 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:384x288	55 AA 07 02 00 02 00 00 00 00 07 F0
		00 00 00 01	N:320x240	55 AA 07 02 00 02 00 00 00 01 06 F0
		00 00 00 02	P:360x288	55 AA 07 02 00 02 00 00 00 02 05 F0
		00 00 00 03	N:360x240	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 00XOR 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 02XOR F0
		00 00 00 03	Hot Iron	55 AA 07 02 00 04 00 00 00 03XOR 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 05XOR F0
		00 00 00 06	Rainbow 1	55 AA 07 02 00 04 00 00 00 06XOR 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 08XOR F0
		00 00 00 09	Black hot	55 AA 07 02 00 04 00 00 00 09XOR 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 image in X direction	55 AA 07 02 00 05 00 00 00 01 01 F0
		00 00 00 02	Mirror image in Y direction	55 AA 07 02 00 05 00 00 00 02 02 F0
		00 00 00 03	Mirror images in X and Y directions	55 AA 07 02 00 05 00 00 00 03 03 F0
EZOOM		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 the center of zoomed area	0x07	00 00 xxxx(MSB)	0~width-1	55 AA 07 02 00 07 00 00 xx xx XOR F0
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	00 00 0000	Off	55 AA 07 02 00 09 00 00 00 00 0C F0
		00 00 0001	On	55 AA 07 02 00 09 00 00 00 01 0D F0

(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 5-6 for details.

Table 5-6 Operation commands of digital video page

Option content	Option	Command word	Operation content	Operation command
External synchronization switch	0x01	00 00 00 00	Off	55 AA 07 02 01 01 00 00 00 00 05 F0
		00 00 00 01	On	55 AA 07 02 01 01 00 00 00 01 04 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	BT.656	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
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
MIPI 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 0000 01	Compensation	55 AA 07 02 01 08 00 00 00 01 0D 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 5-7 for details.

Table 5-7 Operation commands of algorithm setting page

Option content	Option	Command word	Operation content	Operation command
Time-domain filtering switch	0x01	00 00 00 00	Off	55 AA 07 02 02 01 00 00 00 00 06 F0
		00 0000 01	On	55 AA 07 02 02 01 00 00 00 01 07 F0
Filtering strength	0x02	00 0000 00	Level 0	55 AA 07 02 02 02 00 00 00 00 05 F0
		00 0000 01	Level 1	55 AA 07 02 02 02 00 00 00 01 04 F0
		00 0000 02	Level 2	55 AA 07 02 02 02 00 00 00 02 07 F0
		00 0000 03	Level 3	55 AA 07 02 02 02 00 00 00 03 06 F0
		00 0000 04	Level 4	55 AA 07 02 02 02 00 00 00 04 01 F0
Vertical strip	0x03	00 00 00 00	Off	55 AA 07 02 02 03 00 00 00 00 04 F0

removal switch		00 0000 01	On	55 AA 07 02 02 03 00 00 00 01 05 F0
Vertical strength strip	0x04	00 0000 00	Level 0	55 AA 07 02 02 04 00 00 00 00 03 F0
		00 0000 01	Level 1	55 AA 07 02 02 04 00 00 00 01 02 F0
		00 0000 02	Level 2	55 AA 07 02 02 04 00 00 00 02 01 F0
		00 0000 03	Level 3	55 AA 07 02 02 04 00 00 00 03 00 F0
		00 0000 04	Level 4	55 AA 07 02 02 04 00 00 00 04 07 F0
Sharpening switch	0x05	00 00 00 00	Off	55 AA 07 02 02 05 00 00 00 00 02 F0
		00 0000 01	On	55 AA 07 02 02 05 00 00 00 01 03 F0
Sharpening strength	0x06	00 0000 00	Level 0	55 AA 07 02 02 06 00 00 00 00 01 F0
		00 0000 01	Level 1	55 AA 07 02 02 06 00 00 00 01 00 F0
		00 0000 02	Level 2	55 AA 07 02 02 06 00 00 00 02 03 F0
		00 0000 03	Level 3	55 AA 07 02 02 06 00 00 00 03 02 F0
		00 0000 04	Level 4	55 AA 07 02 02 06 00 00 00 04 05 F0
Dimming mode	0x07	00 0000 00	Linear	55 AA 07 02 02 07 00 00 00 00 00 F0
		00 0000 01	Platform	55 AA 07 02 02 07 00 00 00 01 01 F0
		00 0000 02	Hybrid	55 AA 07 02 02 07 00 00 00 02 02 F0
Proportion of upper throwing point	0x08	00 0000 xx	0~20	55 AA 07 02 02 08 00 00 00 xx XOR F0
Proportion of lower throwing point	0x09	00 0000 xx	0~20	55 AA 07 02 02 09 00 00 00 xx XOR F0
Brightness	0x0a	00 0000 xx	0~100	55 AA 07 02 02 0a 00 00 00 xx XOR F0
Contrast	0x0b	00 0000 xx	0~100	55 AA 07 02 02 0b 00 00 00 xx XOR F0
Hybrid dimming mapping range	0x0c	00 0000 xx	0~255	55 AA 07 02 02 0c 00 00 00 xx XOR F0
Y8 correction switch	0x0d	00 00 00 00	Off	55 AA 07 02 02 0d 00 00 00 00 0A F0
		00 0000 01	On	55 AA 07 02 02 0d 00 00 00 01 0B F0
Y8 correction expectation	0x0e	00 0000 xx	0~255	55 AA 07 02 02 0e 00 00 00 xx XOR F0
Enhancement selection	0x0f	00 00 00 00	IDE	55 AA 07 02 02 0f 00 00 00 00 08 F0
		00 00 00 01	LOG	55 AA 07 02 02 0f 00 00 00 01 09 F0
IDE enhancement	0x10	00 00 00 00	Off	55 AA 07 02 02 10 00 00 00 00 17 F0

switch		00 00 00 01	On	55 AA 07 02 02 10 00 00 00 01 16 F0
IDE filtering level	0x11	00 0000 00	Level 0	55 AA 07 02 02 11 00 00 00 00 16 F0
		00 0000 01	Level 1	55 AA 07 02 02 11 00 00 00 01 17 F0
		00 0000 02	Level 2	55 AA 07 02 02 11 00 00 00 02 14 F0
		00 0000 03	Level 3	55 AA 07 02 02 11 00 00 00 03 15 F0
		00 0000 04	Level 4	55 AA 07 02 02 11 00 00 00 04 12 F0
IDE detail gain	0x12	00 0000 xx	0~255	55 AA 07 02 02 12 00 00 00 xx XOR F0
LOG enhancement switch	0x13	00 00 00 00	Off	55 AA 07 02 02 13 00 00 00 00 14 F0
		00 00 00 01	On	55 AA 07 02 02 13 00 00 00 01 15 F0

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

Focusing page

All operation command formats of the focusing page: (55 AA 07 03 00 + option + command word (4 byte) + XOR + F0). See Table 5-8 for details.

Table 5-8 Operation commands of focusing page

Option content	Option	Command word	Operation content	Operation command
Lens selection (to be added or deducted based on product planning)	0x01	00 00 00 00	19mm	55 AA 07 03 00 01 00 00 00 00 05 F0
		00 00 00 01	25mm	55 AA 07 03 00 01 00 00 00 01 04 F0
		00 00 00 02		55 AA 07 03 00 01 00 00 00 02 07 F0
		00 00 00 03		55 AA 07 03 00 01 00 00 00 03 06 F0
		
Manual focusing speed	0x02	00 0000 xx	1~10	55 AA 07 03 00 02 00 00 00 xx XOR F0
Automatic statistics of automatic focusing	0x03	00 0000 xx	1~50	55 AA 07 03 00 03 00 00 00 xx XOR F0
MAX automatic focusing speed	0x04	00 0000 xx	1~10	55 AA 07 03 00 04 00 00 00 xx XOR F0
MIN automatic	0x05	00 0000 xx	1~10	55 AA 07 03 00 05 00 00 00 xx XOR F0

focusing speed				
Focus mode	0x06	00 00 00 00	Stop	55 AA 07 03 00 06 00 00 00 00 02 F0
		00 00 00 01	Manual far focus	55 AA 07 03 00 06 00 00 00 01 03 F0
		00 00 00 02	Manual near focus	55 AA 07 03 00 06 00 00 00 02 00 F0
		00 00 00 03	Automatic focusing	55 AA 07 03 00 06 00 00 00 03 01 F0

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 5-9 for details.

Table 5-9 Operation commands of defective pixel page

Option content	Option	Command word	Operation content	Operation command
Cross cursor switch	0x01	00 00 00 00	Off	55 AA 07 03 01 01 00 00 00 00 04 F0
		00 00 00 01	On	55 AA 07 03 01 01 00 00 00 01 05 F0
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
Display of AD value				
Defective pixel addition	0x04	00 00 00 01	Setting	55 AA 07 03 01 04 00 00 00 01 00 F0
Defective pixel saving	0x05	00 00 00 01	Setting	55 AA 07 03 01 05 00 00 00 01 01 F0
Cursor color R	0x06	00 00 00 xx	Red component	55 AA 07 03 01 06 00 00 00 xx XOR F0
Cursor color G	0x07	00 00 00 xx	Green Component	55 AA 07 03 01 07 00 00 00 xx XOR F0
Cursor color B	0x08	00 00 00 xx	Blue	55 AA 07 03 01 08 00 00 00 xx XOR F0

			component	
--	--	--	-----------	--

Menu function page

All operation command formats of the menu page: (55 AA 07 0302 + option + command word (4 byte) + XOR+ F0). See Table 5-10 for details.

Table 5-10 Operation commands of menu function page

Option content	Option	Command word	Operation content	Operation command
#1 small icon switch	0x01	00 00 00 00	Off	55 AA 07 03 02 01 00 00 00 00 07 F0
		00 00 00 01	On	55 AA 07 03 02 01 00 00 00 01 06 F0
#1 small icon width	0x02	00 00 00 xx	1~64	55 AA 07 03 02 02 00 00 00 xx XOR F0
#1 small icon coordinate X	0x03	00 00 xx xx	0~width-width	55 AA 07 03 02 03 00 00 xx xx XOR F0
#1 small icon coordinate Y	0x04	00 00 xx xx	0~height-width	55 AA 07 03 02 04 00 00 xx xx XOR F0
#2 small icon switch	0x05	00 00 00 00	Off	55 AA 07 03 02 05 00 00 00 00 03 F0
		00 00 00 01	On	55 AA 07 03 02 05 00 00 00 01 02 F0
#2 small icon width	0x06	00 00 00 xx	1~64	55 AA 07 03 02 06 00 00 00 xx XOR F0
#2 small icon coordinate X	0x07	00 00 xx xx	0~width-width	55 AA 07 03 02 07 00 00 xx xx XOR F0
#2 small icon coordinate Y	0x08	00 00 xx xx	0~height-width	55 AA 07 03 02 08 00 00 xx xx XOR F0
Small icon transparency setting	0x09	00 00 xx xx	0~4	55 AA 07 03 02 09 00 00 xx xx XOR F0
Menu bar switch	0x0a	00 00 00 00	Off	55 AA 07 03 02 0a 00 00 00 00 0C F0
		00 00 00 01	On	55 AA 07 03 02 0a 00 00 00 01 0D F0
Menu bar location setting	0x0b	00 00 xxxx	0~height-16	55 AA 07 03 02 0b 00 00 xx xx XOR F0
Menu bar transparency setting	0x0c	00 00 00xx	0~4	55 AA 07 03 02 0c 00 00 00 xx XOR F0

Layer switch	0x0d	00 00 00 00	Off	55 AA 07 03 02 0d 00 00 00 00 0B F0
		00 00 00 01	On	55 AA 07 03 02 0d 00 00 00 01 0A F0
Layer transparency setting	0x0e	00 00 xx xx	0~4	55 AA 07 03 02 0e 00 00 xx xx XOR F0
Half pixel cursor switch	0x0f	00 00 00 00	Off	55 AA 07 03 02 0f 00 00 00 00 09 F0
		00 00 00 01	On	55 AA 07 03 02 0f 00 00 00 01 08 F0
Half pixel cursor coordinate X	0x10	00 00 xx xx	0~width	55 AA 07 03 02 10 00 00 xx xx XOR F0
Half pixel cursor coordinate Y	0x11	00 00 xx xx	0~height	55 AA 07 03 02 11 00 00 xx xx XOR F0
Half pixel color setting	0x12	00 xx xx xx	RGB value	55 AA 07 03 02 12 00 xx xx xx XOR F0

6.2.1.1.4 Temperature measurement page

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 Table5-11.

Table 5-11 Operation commands of parameter setting 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
Temperature Show	0x04	00 00 00 00	degree Celsius	55 AA 07 04 00 04 00 00 00 00 07 F0
		00 00 00 01	degree Fahrenheit	55 AA 07 04 00 04 00 00 00 01 06 F0

		00 00 00 02	degree Kelvin	55 AA 07 04 00 04 00 00 00 02 05 F0
Temperature Calibration	0x05	00 00 xx xx	-32768~32767	55 AA 07 04 00 05 00 00 xx xx XOR F0
Factory reset	0x06	00 00 00 01		55 AA 07 04 00 06 00 00 00 01 04 F0
Reflected setting	0x07	00 00 xx xx		55 AA 07 04 00 07 00 00 xx xx XOR F0
Save settings	0x04	00 00 00 01		55 AA 07 01 00 04 00 00 00 01 03 F0
Humidity Save settings	0x08	00 00 00 xx		55 AA 07 04 00 08 00 00 00 xx XOR F0
Temperature measurement range	0x09	00 00 00 00	-40°C~+150°C, (factory default)	55 AA 07 04 00 09 00 00 00 00 0A F0
		00 00 00 01	-40°C~550°C	55 AA 07 04 00 09 00 00 00 01 0B F0

Blackbody correction page

All operation commands of the function blackbody correction page: (55 AA 07 04 01 + option + command word (4 bytes) + XOR + F0) .

For the use of black body correction page, please refer to the secondary calibration guidance.

Area measurement page

All operation commands of the function area measurement page: (55 AA 07 04 02 + option + command word (4 bytes) + XOR + F0) . The command contents are specified as shown in Table5-12.

Table5-12 Operation commands of Area measurement page

Option content	Option	Command word	Operation content	Operation command
Area temperature switch	0x01	00 00 00 00	off	55 AA 07 04 02 01 00 00 00 00 00 F0
		00 00 00 01	on	55 AA 07 04 02 01 00 00 00 01 01 F0
The area selected command	0x02	00 00 00 01	Area one	55 AA 07 04 02 02 00 00 00 01 02 F0
		00 00 00 02	Area two	55 AA 07 04 02 02 00 00 00 02 01 F0
		00 00 00 03	Area three	55 AA 07 04 02 02 00 00 00 03 00 F0
the starting coordinate X	0x03	00 00 xx xx		55 AA 07 04 02 03 00 00 xx xx XOR F0
the starting coordinate Y	0x04	00 00 xx xx		55 AA 07 04 02 04 00 00 xx xx XOR F0
Region width	0x05	00 00 xx xx		55 AA 07 04 02 05 00 00 xx xx XOR F0
Region height	0x06	00 00 xx xx		55 AA 07 04 02 06 00 00 xx xx XOR F0
Area one	0x07	00 00 00 00	off	55 AA 07 04 02 07 00 00 00 00 06 F0

temperature switch		00 00 00 01	on	55 AA 07 04 02 07 00 00 00 01 07 F0
Area two temperature switch	0x08	00 00 00 00	off	55 AA 07 04 02 08 00 00 00 00 09 F0
		00 00 00 01	on	55 AA 07 04 02 08 00 00 00 01 08 F0
Area three temperature switch	0x09	00 00 00 00	off	55 AA 07 04 02 09 00 00 00 00 08 F0
		00 00 00 01	on	55 AA 07 04 02 09 00 00 00 01 09 F0

6.2.1.2 Query command

The query commands are as shown in Table 5-13.

Table 5-13 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	0xFF	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 5-14.

Table 5-14 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 5-15 for details of return command.

Table 5-15 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	
	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
0x1F	Upload B5
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
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	
	0x44	Single point collection completed	
	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 Table5-16、5-17、5-18.

Table 5-16 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 5-17 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 5-18 Format of 45-bytes query return command

Frame	Length	Valid command word	Frame	Length
-------	--------	--------------------	-------	--------

header			Functional classification	Page	Option	header	
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 slave computer are described in Table 5-19, 5-20, 5-21.

Table 5-19 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	
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

Table5-20 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
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

Table5-21 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	
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	
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	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	
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	
Byte44	0xF0	Frame end	Frame end

6.2.2.2.1 Status page

Query response command contents of the status page are as shown in Table 5-22.

Table 5-22 Commands of status 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	0x00	Status page	Functional classification
Byte4	0x00	Page 1	Page number
Byte5	0x00	Radiometric type	ID number of module
	0x01	Non-radiometric type	
	0x02	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	0x00	400×300	ID number of resolution
	0x01	384×288	
	0x02	360×288	
	0x03	320×240	
	0x04	360×240	
	0x05	160×120	
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 response command contents of the setup page are as shown in Table 5-23.

Table 5-23 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 on	
	0x01	The rising of temperature calibration switch off	
Byte9	0x00	Automatic shutter control	
	0x01	Manual shutter control	
Byte10~ 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 5-24.

Table 5-24 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	Command of option 1
	0x01	Analog video on	
Byte6	0x00	P-system 384x288	Command of option 2
	0x01	N-system 320x240	
	0x02	P-system 360x288	
	0x03	N-system 360x240	
Byte7 P-system 50/25/9 N-system 60/30/9	0x00	50/60Hz	Command of option 3
	0x01	25/30Hz	
	0x02	9Hz	
Byte8	xx	Pseudo-color	Command of option 4
Byte9	0x00	No	Command of option 5
	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	Command of option 6
Byte11	xx	Coordinate X [15:0] of the center of zoomed area	Command of option 7
Byte12	xx	Coordinate X [7:0] of the center of zoomed area	
Byte13	xx	Coordinate Y [15:0] of the center of zoomed area	Command of option 8
Byte14	xx	Coordinate Y [7:0] of the center of zoomed area	

Byte15	0x00	Hotspot track off	Command of option 9
	0x01	Hotspot track on	
Byte16~ Byte21	0x00	Reserved	
Byte22	0xXX	Checksum	Check bit
Byte23	0xF0	Frame end	Frame end

Digital video page

Query response command contents of the digital video page are as shown in Table 5-25.

Table 5-25 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	Command of option 1
	0x01	External synchronization enabling on	
Byte6	0x00	Digital port parallel off	Command of option 2
	0x01	Digital port BT.656	
	0x02	Digital port CMOS	
Byte7	0x00	YUV422	Command of option 3 Parallel output contents
	0x01	YUV422_ parameter line	
	0x02	YUV16	
	0x03	YUV16_ parameter line	
	0x04	Y16_YUV422	
	0x05	Y16_ parameter line_ YUV422	
Byte8	0x00	CMOS16	

	0x01	CMOS8(MSB first)	Command of option 4 Parallel output interface type
	0x02	CMOS8(LSB first)	
Byte9	0x00	50/60Hz	Command of option 5
	0x01	25/30Hz	
	0x02	9Hz	
Byte10	00 00 00 00	Off	Command of option 6 MIPI switch
	00 00 00 01	On	
Byte11~ Byte21	0x00	Reserved	
Byte22	0xXX	Checksum	Check bit
Byte23	0xF0	Frame end	Frame end

Algorithm control page 1

Query response command contents of the algorithm control page 1 are as shown in Table 5-26.

Table 5-26 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 3)	Page
Byte5	0x00	Time-domain filtering off	Command of option 1
	0x01	Time-domain filtering on	
Byte6	0x00	Level 0	Command of option 2 Filtering strength
	0x01	Level 1	
	0x02	Level 2	
	0x03	Level 3	
	0x04	Level 4	
Byte7	0x00	Vertical strip removal off	Command of option 3
	0x01	Vertical strip removal on	

Byte8	0x00	Level 0	Command of option 4 Vertical strip strength
	0x01	Level 1	
	0x02	Level 2	
	0x03	Level 3	
	0x04	Level 4	
Byte9	0x00	Sharpening off	Command of option 5
	0x01	Sharpening on	
Byte10	0x00	Level 0	Command of option 6 Sharpening strength
	0x01	Level 1	
	0x02	Level 2	
	0x03	Level 3	
	0x04	Level 4	
Byte11	0x00	Linear	Command of option 7 Dimming mode
	0x01	Platform	
	0x02	Hybrid	
Byte12	xx	Proportion of upper throwing point 0~20	Command of option 8
Byte13	xx	Proportion of lower throwing point 0~20	Command of option 9
Byte14	xx	Brightness	Command of option 10
Byte15	xx	Contrast	Command of option 11
Byte16	xx	Hybrid dimming mapping	Command of option 12
Byte17~ Byte21	0x00	Reserved	
Byte22	0xXX	Checksum	Check bit
Byte23	0xF0	Frame end	Frame end

Algorithm control page 2

Query response command contents of the algorithm control page 2 are as shown in Table 5-27.

Table 5-27 Algorithm control page 2

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	0x03	Digital video page (page 3)	Page
Byte5	0x00	Y8 correction off	Command of option 13
	0x01	Y8 correction on	
Byte6	xx	Y8 correction expectation 0~255	Command of option 14
Byte7	0x00	IDE	Command of option 15
	0x01	LOG	
Byte8	0x00	IDE enhancement off	Command of option 16
	0x01	IDE enhancement on	
Byte9	xx	IDE filtering level 0~4	Command of option 17
Byte10	xx	IDE detail gain 0~127	Command of option 18
Byte11	00	LOG enhancement off	Command of option 19
	01	LOG enhancement on	
Byte12~Byte21	0x00	Reserved	
Byte22	0xFF	Checksum	Check bit
Byte23	0xF0	Frame end	Frame end

6. 2. 2. 2. 4 Application page

Focusing page

Query response command contents of the focusing page are as shown in Table 5-28.

Table 5-28 Commands of focusing 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	0x00	Focusing page (page 1)	Page
Byte5	xx	Lens type	Command of option 1
Byte6	xx	Manual focusing speed 1~10	Command of option 2
Byte7		Statistic frame number of automatic focusing 1~15	Command of option 3
Byte8	xx	Automatic focusing speed MAX1~10	Command of option 4
Byte9	xx	Automatic focusing speed MIN1~10	Command of option 5
Byte10~Byte21	0x00	Reserved	
Byte22	0xXX	Checksum	Check bit
Byte23	0xF0	Frame end	Frame end

Defective pixel page

Query response command contents of the defective pixel page are as shown in Table 5-29.

Table 5-29 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	0x00	Cross cursor off	Command of option 1
	0x01	Cross cursor on	
Byte6	xx	Cursor location X[15:8]	Command of option 2
Byte7	xx	Cursor location X[7:0]	
Byte8	xx	Cursor location Y[15:8]	Command of option 3
Byte9	xx	Cursor location Y[7:0]	
Byte10~Byte21	0x00	Reserved	

Byte22	0xXX	Checksum	Check bit
Byte23	0xF0	Frame end	Frame end

Menu function page 1

Query response command contents of the menu function page 1 are as shown in Table 5-30.

Table 5-30 Commands of menu function 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	0x03	Application	Functional classification
Byte4	0x02	Menu page (page 3)	Page
Byte5	0x00	#1 small icon display off	Command of option 1
	0x01	#1 small icon display on	
Byte6	xx	#1 small icon width	Command of option 2
Byte7	xx	#1 small icon location setting X[15:8]	Command of option 3
Byte8	xx	#1 small icon location setting X[7:0]	
Byte9	xx	#1 small icon location setting Y[15:8]	Command of option 4
Byte10	xx	#1 small icon location setting Y[7:0]	
Byte11	0x00	#2 small icon display off	Command of option 5
	0x01	#2 small icon display on	
Byte12	xx	#2 small icon width	Command of option 6
Byte13	xx	#2 small icon location setting X[15:8]	Command of option 7

Byte14	xx	#2 small icon location setting X[7:0]	
Byte15	xx	#2 small icon location setting Y[15:8]	Command of option 8
Byte16	xx	#2 small icon location setting Y[7:0]	
Byte17	0x00	Small icon transparency setting 0~4	Command of option 9
Byte17~ Byte21		Reserved	
Byte22	0xXX	Checksum	Check bit
Byte23	0xF0	Frame end	Frame end

Menu function page 2

Query response command contents of the menu function page 2 are as shown in Table 5-31.

Table 5-31 Commands of menu function page 2

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	0x03	Menu page (page 3)	Page
Byte5	0x00	Menu bar display off	Command of option 10
	0x01	Menu bar display on	
Byte6	xx	Menu bar location setting [15:8]	Command of option 11
Byte7	xx	Menu bar location setting [7:0]	
Byte8	xx	Menu bar transparency level	Command of option 3
Byte9	0x00	Layer display off	Command of option 13
	0x01	Layer display on	
Byte10	xx	Layer	Command of option 14

		transparency setting	
Byte11	0x00	Half pixel cursor off	Command of option 15
	0x01	Half pixel cursor on	
Byte12	xx	Half pixel cursor location setting X[15:8]	Command of option 16
Byte13	xx	Half pixel cursor location setting X[7:0]	
Byte14	xx	Half pixel cursor location setting Y[15:8]	Command of option 17
Byte15	xx	Half pixel cursor location setting Y[7:0]	
Byte16	xx	Half pixel color label [23:16]	Command of option 18
Byte17	xx	Half pixel color label [15:8]	
Byte18	xx	Half pixel color label [7:0]	
Byte19~ Byte21	0x00	Reserved	
Byte22	0xXX	Checksum	Check bit
Byte23	0xF0	Frame end	Frame end

6.2.2.2.5 Temperature measurement page

(1) Parameter setting page

Query response command contents of the temperature measurement page are as shown in Table 5-32.

Table5-32 command contents of the parameter setting page

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	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	spot
	01	Cross cursor spot+ maximum temperature	
	02	minimum + Cross cursor spot temperature	
Byte8	00	Temperature unit: °C	
	01	Temperature unit: °F	
	02	Temperature unit: °K	
Byte9	0x00	Reserved	
Byte10	0x00	Reserved	
Byte11	xx	Coordinate X [15:0] 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 [15:0] 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 [15:0] is based on byte7 value	
Byte18	xx	Coordinate X [7:0] 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. (actual temperature*10)
Byte19	xx	Coordinate Y [15:0] is based on byte7 value	
Byte20	xx	Coordinate Y [7:0] is based on byte7 value	
Byte21	xx	The temperature[15 : 8] after calibration is based on setting of byte7 value	
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 response command contents of the blackbody correction page are as shown in Table 5-33.

Table5-33 command contents of the blackbody correction page

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

(3) Area measurement page

Query response command contents of the area measurement page are as shown in Table 5-34.

Table5-34 command contents of the area measurement page

Command word	Byte	Parameter description	Parameter type
Byte0	0x55	Frame header byte 1	Frame header
Byte1	0xAA	Frame header byte 2	
Byte2	0x28	Length is 40	Command length
Byte3	0x04	Measurement page	Functional classification
Byte4	0x02	Page 3	Page number
Byte5	xx	Switch of area temperature measurement	0: off 1:on
Byte6	xx	Option of area temperature measurement	1: area one 2: area two 3:area three
Byte7	xx	Area coordinate setting X [15:0]	
Byte8	xx	Area coordinate setting X [7:0]	
Byte9	xx	Area coordinate setting Y [15:0]	
Byte10	xx	Area coordinate setting Y [7:0]	
Byte11	xx	Area width W[15:8]	
Byte12	xx	Area width W[7:0]	
Byte13	xx	Area Height H[15:8]	
Byte14	xx	Area Height H[7:0]	
Byte15	xx	Switch of area one	0: off 1:on
Byte16	xx	Switch of area two	
Byte17	xx	Switch of area three	
Byte18	xx	Maximum temp. coordinate X [15:8]	
Byte19	xx	Maximum temp. coordinate X [7:0]	
Byte20	xx	Maximum temp. coordinate Y [15:8]	
Byte21	xx	Maximum temp. coordinate Y[7:0]	
Byte22	xx	Maximum temperature [15 : 8]	actual temperature*10
Byte23	xx	Maximum temperature [7 : 0]	
Byte24	xx	Minimum temp. coordinate X [15:8]	
Byte25	xx	Minimum temp. coordinate X [7:0]	
Byte26	xx	Minimum temp. coordinate Y [15:8]	
Byte27	xx	Minimum temp. coordinate Y [7:0]	
Byte28	xx	Minimum temperature [15 : 8]	actual temperature*10
Byte29	xx	Minimum temperature [7 : 0]	

Byte30	xx	Cross cursor temp. coordinate X [15:8]	
Byte31	xx	Cross cursor temp. coordinate X [7:0]	
Byte32	xx	Cross cursor temp. coordinate Y [15:8]	
Byte33	xx	Cross cursor temp. coordinate Y [7:0]	
Byte34	xx	Cross cursor temperature [15 : 8]	actual temperature*10
Byte35	xx	Cross cursor temperature [7 : 0]	
Byte36	xx	Average temperature [15 : 8]	actual temperature*10
Byte37	xx	Average temperature [7 : 0]	
Byte38~ Byte42		Reserved	
Byte43	0xXX	XOR checkout	Check bit
Byte44	0xF0	Frame end	Frame end

7 Mechanical interface specification

7.1 The structure of bare PLUG module

The structure of bare PLUG module is as shown in Fig. 7-1.

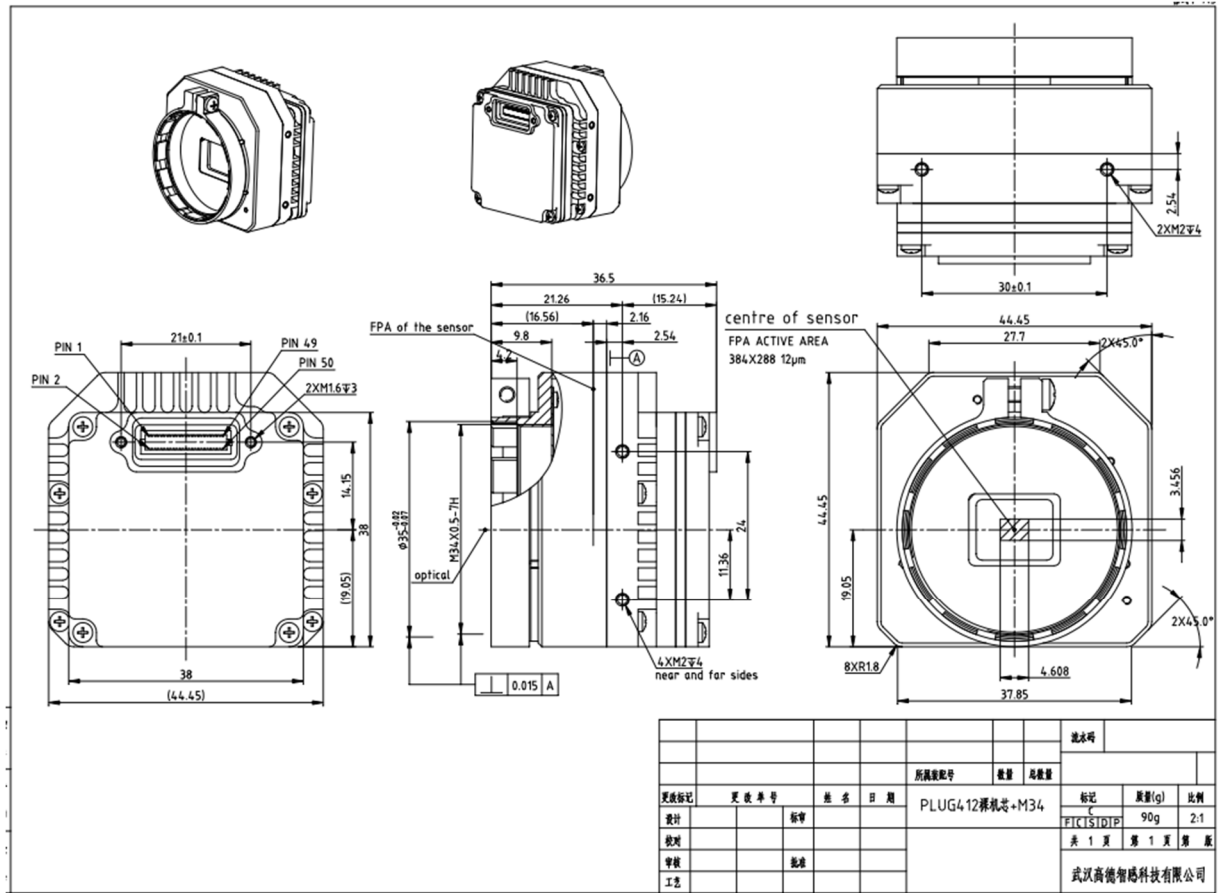


Fig. 7-1 Bare module structure diagram

7.2 The structure of bare PLUG module with M34 lens adapter ring

The structure of bare PLUG module with M34 lens adapter ring is as shown in Fig.7-2.

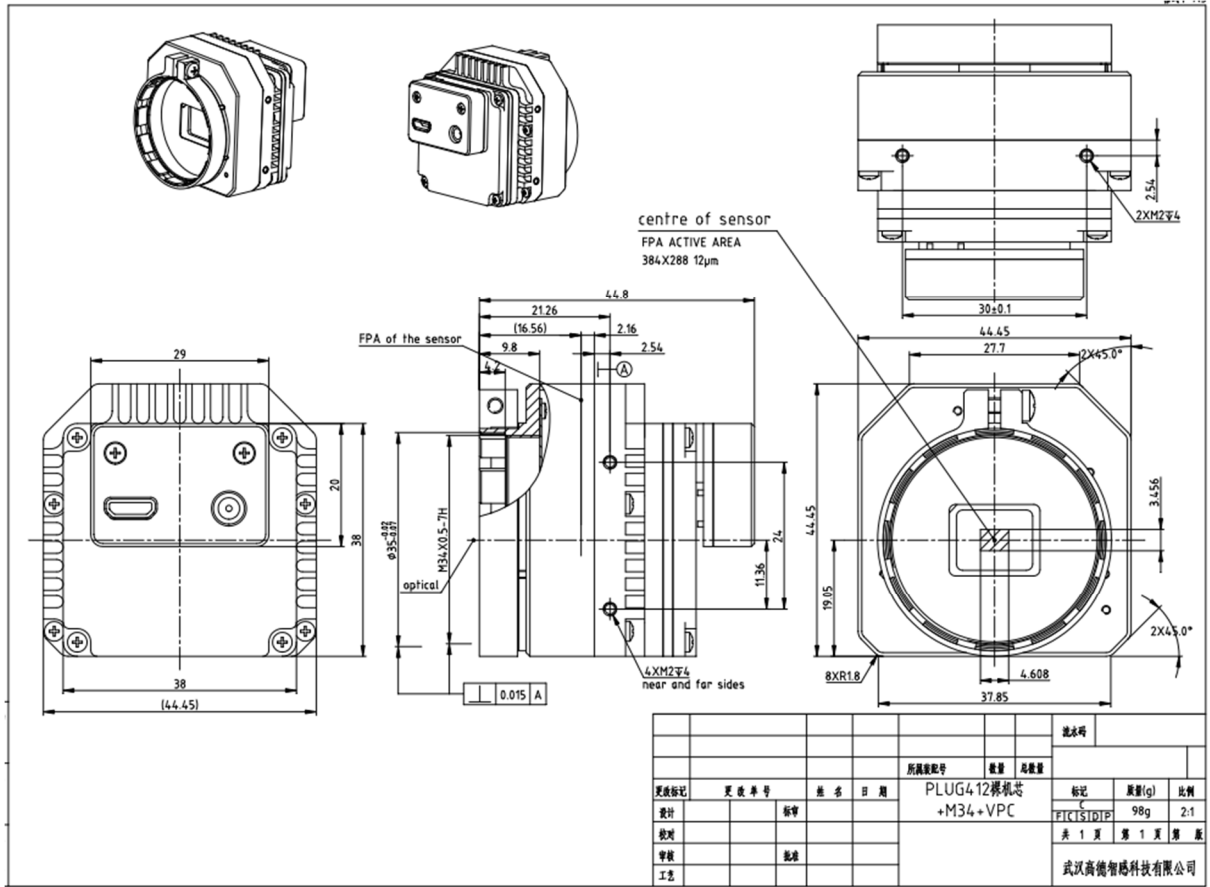


Fig. 7-2 Diagram of the structure with M34 lens adapter ring

7.3 PLUG Tripod interface (Optional)

The PLUG module is provided with an optional tripod adapter by which the module can be fixed on a general tripod. Its structure size is shown in Figure 7-3.

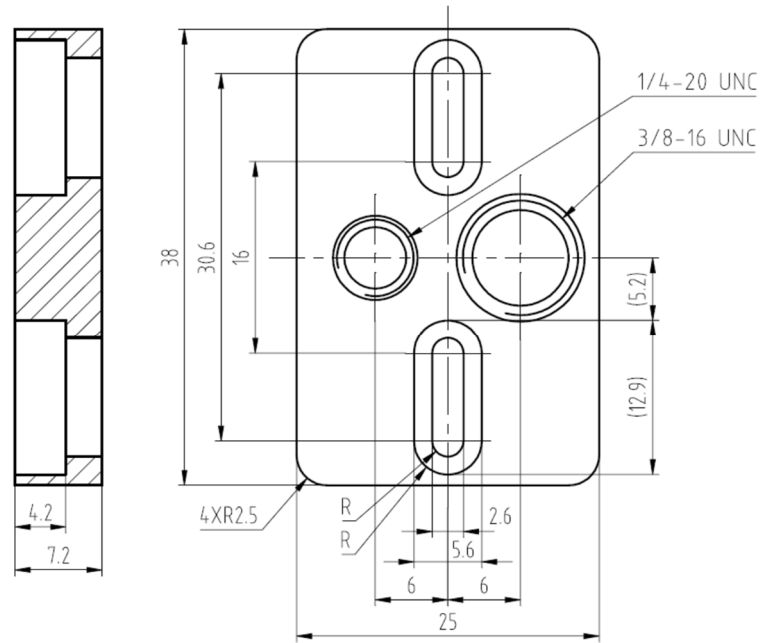


Figure 7-3 Structure diagram of tripod interface