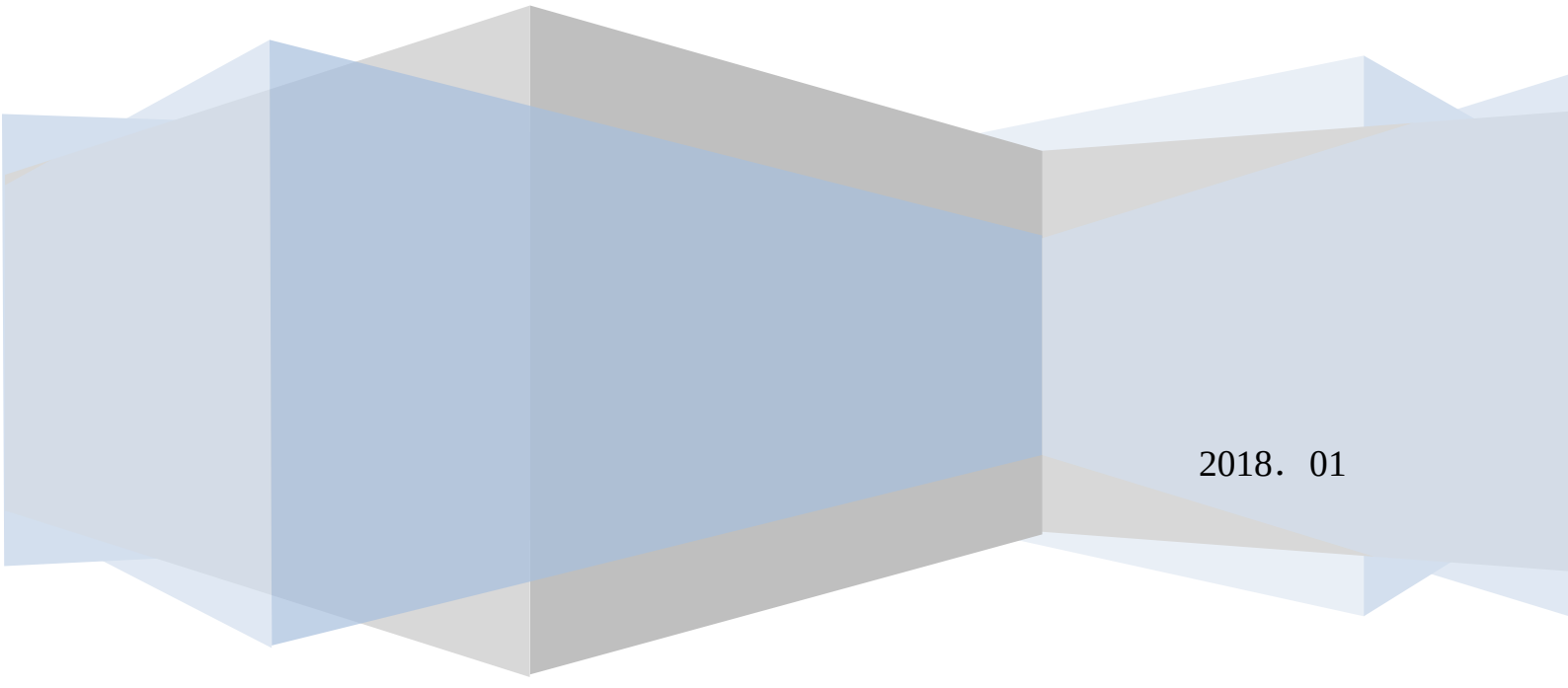
北京嘉恒中自图像技术有限公司
Beijing JoinHope Image Technology Co., Ltd.

OK_AM1566

X-Ray GigE Camera Instructions



2018．01

Contents

1. General description

1.1 Introduction

OK_AM1566 is GigE black-and-white camera specially for X-ray machine. It is widely used in the current 9/12 inch image intensifier. It has high sensitivity, can effectively reduce the dose of X-ray while get richer image details. It has several of I/O ports to control X-ray synchronization. It uses GigE network as data transmission interface, simplifies the connection program, helps customers to reduce the machine cost.
OK_AM1566 is suitable for image capturing fields with high sensitivity such as medical or industrial X-ray, especially for C-Arm and digital gastrointestinal machines.

1.2 Performance

1) Image processing function: Inter-frame recursive noise reduction, Intra-frame filtering, Edge enhancement, Gamma correction, Bad point correction.
2) Expand 0-15 level electric Aperture and ND filter.
3) Hardware achieves the GigE Vision protocol; the processing speed is faster and compatible with the third party GigEVision software.
4) It has the function of Retransmission and continuous transmission to ensure that data is not lost. It ensures correctness and reliability of data by CRC check.

1.3 Product list

A GigE black-and-white camera for X-ray, an I/O cable of the power, a DC 12V power adapter, a GigE cable, and an user CD-ROM.

2. Camera introduction

2.1 Performance

The performance of OK_AM1566 is shown in Table2-1.

Model	OK_AM1566
Frame rate（Hz）	25
Pixel clock	35 MHz
CCD sensor	2/3＂mono progressive
CCD size (mm^2)	6.6×6.6
Pixel size (μm^2)	6.45×6.45
Effective Pixel	1024×1024
AD	12bit
Peak quantum efficiency	62%
Full potential well (e-)	18000
Signal-to-noise ratio (dB)	42
Min Exposure time（μs）	37.7
External trigger mode Max Exposure time（s）	10
Free mode Max Exposure time（ms）	40
Gamma correction	0.1~2.0
Work environment	-5℃ ~ +45℃
Working humidity	20%—80%
Preserving environmental	Temperature: -25℃~60℃ Humidity: 20%~90%
Operating system	Windows98/2000/XP/NT/VISTA/7/8
Lens mount	“C/CS” mount

2.2 Spectral response

The spectral response of OK_AM1566 is shown in Figure 2-1.

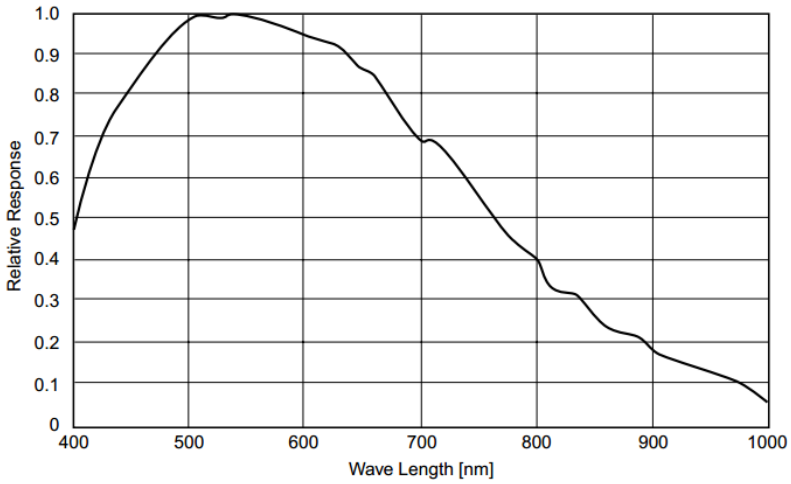


Figure 2-1the spectral response of OK_AM1566

2.3 Appearance

OK_AM1566 has the same appearance structure. The GigE black-and-white camera for X-ray machine mainly has three parts: Adapting disk, Support frame, External protective cover. See Figure 2-2 and Figure 2-3.

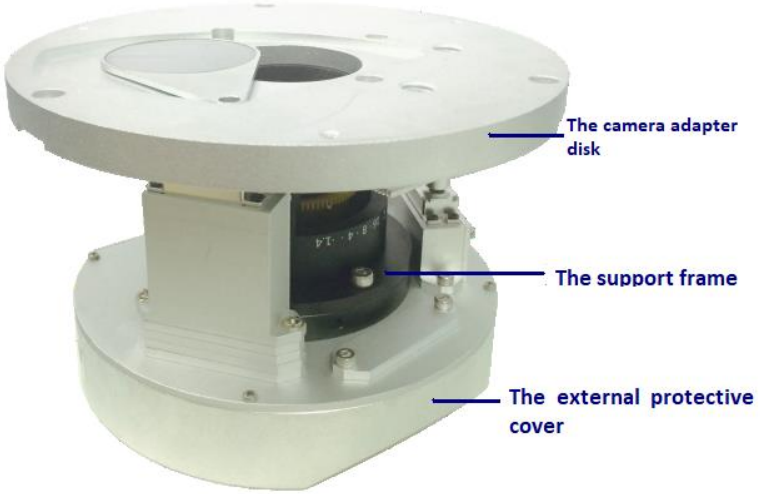


Figure 2-2 OK_AM1566's appearance

- The camera adapter disk is used to connect and fix the camera and image intensifier.
- The support frame is used to support the adapter disk and external protective cover. Users can adjust the height of the support frame according to the size of the image intensifier to install the camera on the image intensifier.

  For different sizes of image intensifiers, we will provide different types of cameras for users to choose, please see appendix A for its specific model.
- The external protective cover is used to protect the camera circuit.

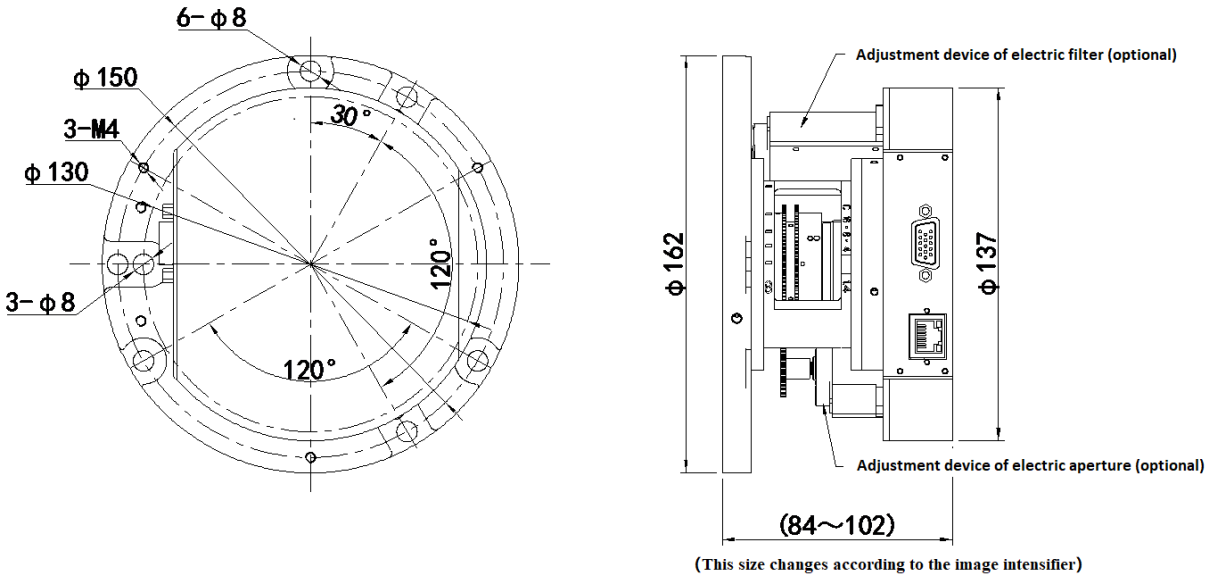


Figure 2-3 OK_AM1566's size

2.4 Interface introduction

The external protective cover has two ports: a HD15 port， a RJ45 socket of standard GigE port, see Figure 2-4.

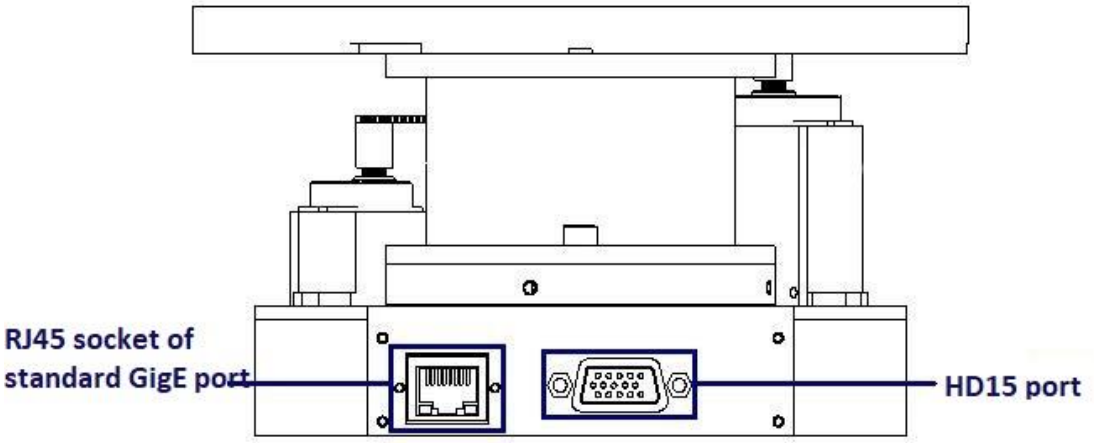


Figure 2-4 Camera's ports

2.4.1 Interface definition of HD15

The pin number of HD15 is shown in Figure 2-5, and its pin definition is shown in Table 2-2.

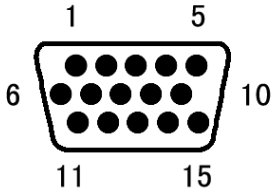


Figure 2-5 the pin number of HD15

Table 2-2 the pin definition of HD15

Pin	Instruction	Color	Remarks
1	Preserve input		
2	Preserve input		
3	null		
4	GND		
5	GND	white	
6	External trigger /External synchronous input	brown	
7	GND		5 pins of serial port DB9
8	RS232_TXD		2 pins of serial port DB9
9	RS232_RXD		3 pins of serial port DB9
10	Power input +12V		
11	null		
12	null		
13	null		
14	External synchronous output	yellow	
15	Power input GND		

2.4.2 Interface definition of GigE

The pin number of RJ45 is shown in Figure 2-6, its pin definition is shown in Table 2-3.

Table 2-3 the pin definition of RJ45

Pin	IN/OUT	Instruction
1	IN/OUT	MX1+ (DA+)
2	IN/OUT	MX1- (DA-)
3	IN/OUT	MX2+ (DB+)
4	IN/OUT	MX3+ (DC+)

5	IN/OUT	X3- (DC-)
6	IN/OUT	MX2- (DB-)
7	IN/OUT	MX4+ (DD+)
8	IN/OUT	MX4- (DD-)

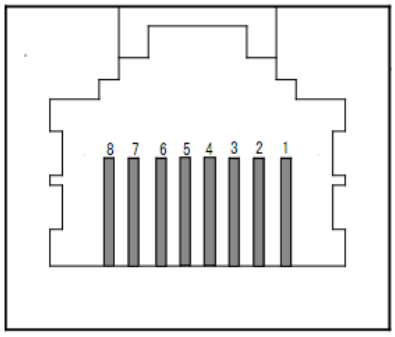


Figure 2-6 the GigE port

2.4.3 Input/output IO port circuit

Input IO port circuit includes preserve input and External trigger /External synchronous input. Its schematic diagram is shown in Figure 2-7. For external input signals, the low level is valid. The GPIO_IN in the picture is an external trigger pulse input port.

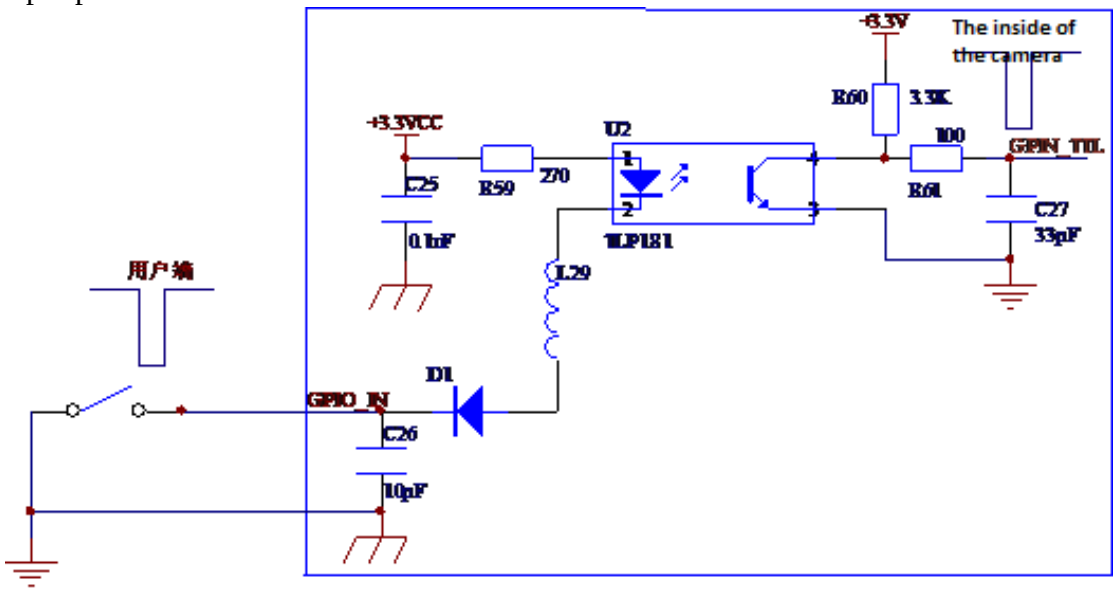


Figure 2-7 input IO port circuit

The schematic diagram of output IO port circuit is shown in Figure 2-8. The output signal is negative pulse. The default is field synchronous output. The width of the negative pulse is different according to the model (2.5ms-5ms).

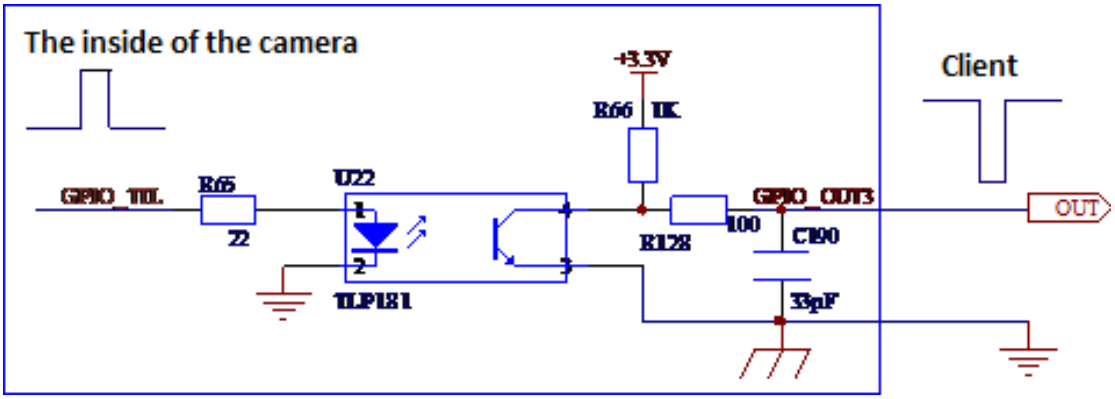


Figure 2-8output IO port circuit

3. Installation

3.1 Electrical connection

The port of the GigE card on the PC connects the GigE port of camera by GigE cable. The HD15 port of camera connects the DC12V power supply. When the user uses the edge trigger mode or pulse width trigger mode, the trigger signal is input by the external trigger input port. If user needs to use serial port to change camera parameters, the serial port should connect DB9 port of PC. Please see Appendix B for serial port command. The overall electrical connection diagram is shown in Figure 3-1.

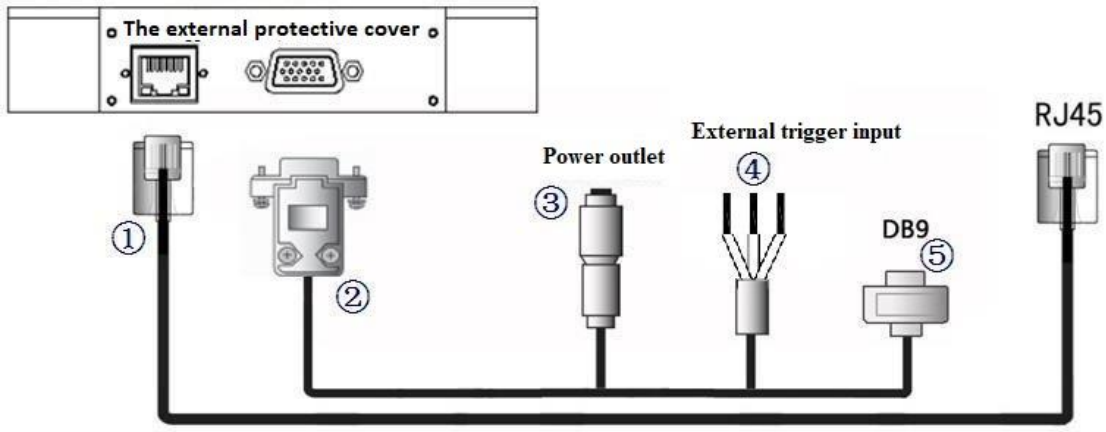


Figure 3-1 the overall electrical connection

Instruction：

1. Data transmission line: connect PC terminal by Gigabit cable to transmit data.
2. HD15 port: Please see 2.4.1 for the pin definition.
3. Power outlet: connect 12V DC power supply.
4. External trigger input: white wire – GND, brown wire – external trigger signal, yellow wire – External synchronous signal.
5. DB9 port: Connect the serial port of PC to set the camera parameters.

3.2 Installation and fixing of camera

1. Before connecting the camera to the image intensifier, the dust on the lens is removed by the blower (air bellow) or soft wet cloth dipped in alcohol.

2. The camera adapter disk is aligned to the image intensifier. Its direction is shown in Figure 3-2. The adapter disk is fixed on the image intensifier by the through-hole on it. As shown in Figure 3-3, there are two groups of through holes (three in each group) on the camera adapter disk. The user can choose a set of through holes that mark the same color in the image, and fix the camera on the image intensifier.

Figure 3-2 Installation of camera

Figure 3-3 the through holes on the adapter disk

3.3 Electric aperture gear

Place the external protective cover upwards. You can see that there is a white gear on the supporting frame of the camera. It is an electric aperture gear. See Figure 3-4.

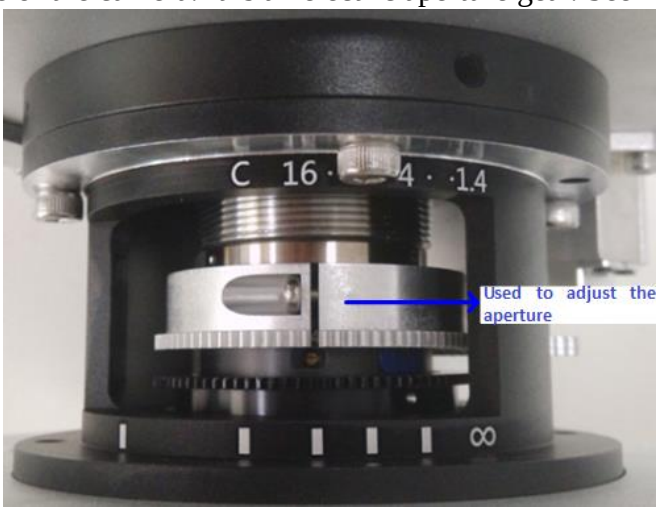


Figure 3-4 the electric aperture gear

The value of electric aperture can be adjusted by software. Please see section 6.4.6 for its operation.

As shown in Figure 3-5, there is a fracture on the electric aperture gear. The scale above corresponding to the fracture represents the value of the aperture.

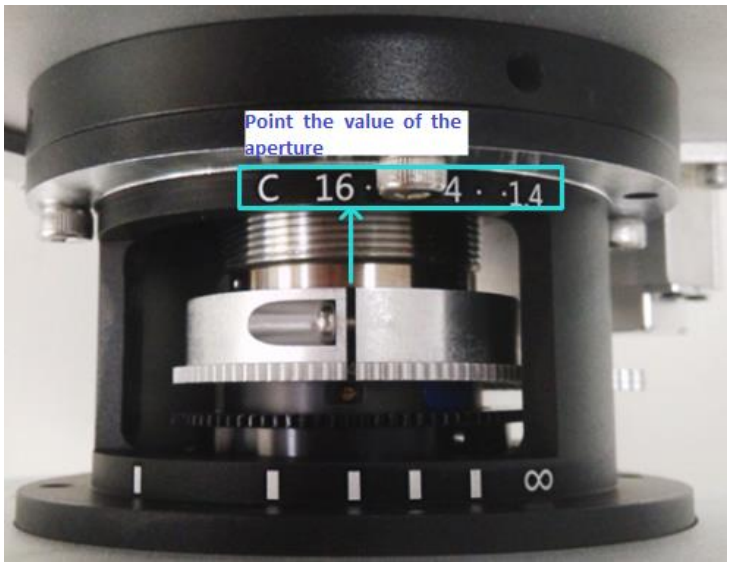


Figure 3-5the value of the aperture

3.4 Focusing gear

As shown in Figure 3-6, a black gear which can also be seen on the supporting frame of the camera is a focusing gear. It is used to adjust the focal length. There is a set screw above the focusing gear for fixing the focusing gear.

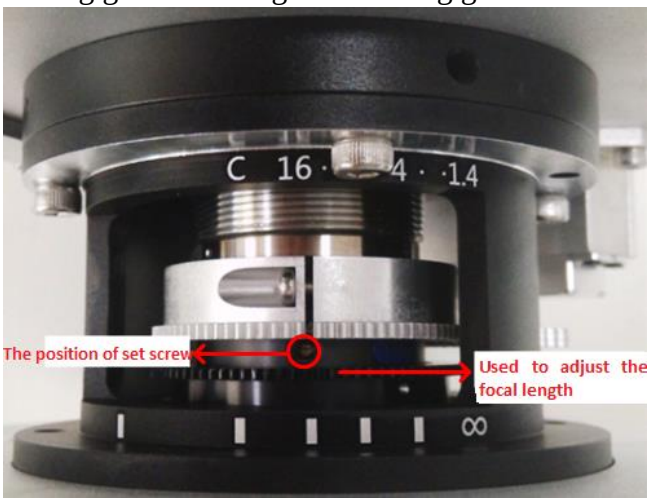


Figure 3-6the focusing gear

If the user needs to adjust the focal length of the camera, the user can use firstly the inner hexagonal screwdriver to loosen the set screw, and then use the slotted screwdriver to move the focusing gear. After adjustment, the user can tighten the set screw and fix the focusing gear.

As shown in Figure 3-7, there is a white circular hole below the focusing gear. The scale below corresponding to the circular hole represents the value of the current focal

length.

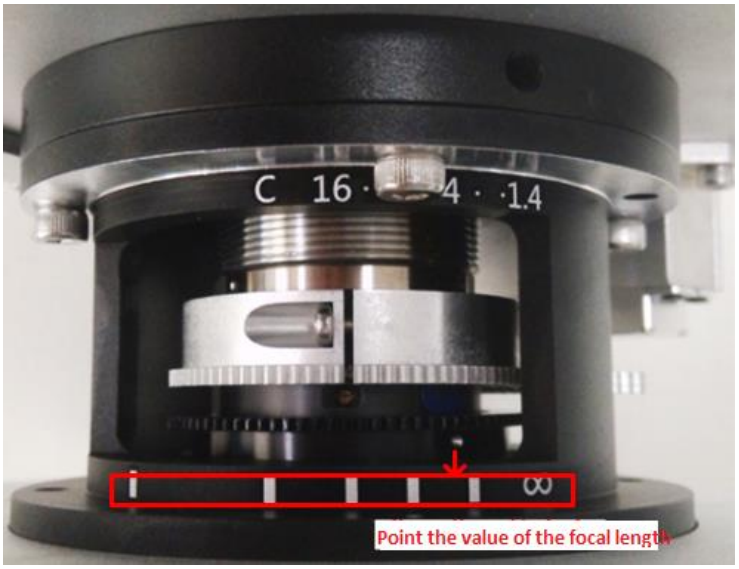


Figure 3-7the value of the current focal length

4. Network adapter installation

4.1 Install network adapter

1. Network adapter drivers

It is recommended to use the Intel Pro 1000 network adapter. The user can run its driver as shown in Figure 4-1, and continue to click "next" until the installation is complete.

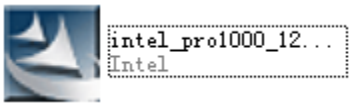


Figure 4-1 the Intel Pro 1000 network adapter's driver

2. Install network adapter

When installing the network adapter, the PC should be shut down and cut off the power supply. Take the network adapter lightly and try not to touch the circuit and PCI of the adapter. Insert the network adapter into the PCI slot and ensure that it is seated.

After starting the computer, the hardware wizard window will pop up (Figure 4-2). The user selects "Install the software automatically (Recommended)", and installs the network adapter driver according to the prompt steps in the window.

Figure 4-2 the hardware wizard window

After installing the network adapter driver successfully, you can see whether the network card is installed successfully from the device manager. The icon displayed in Figure 4-3 is found in "network adapters", and the network adapter is installed correctly.

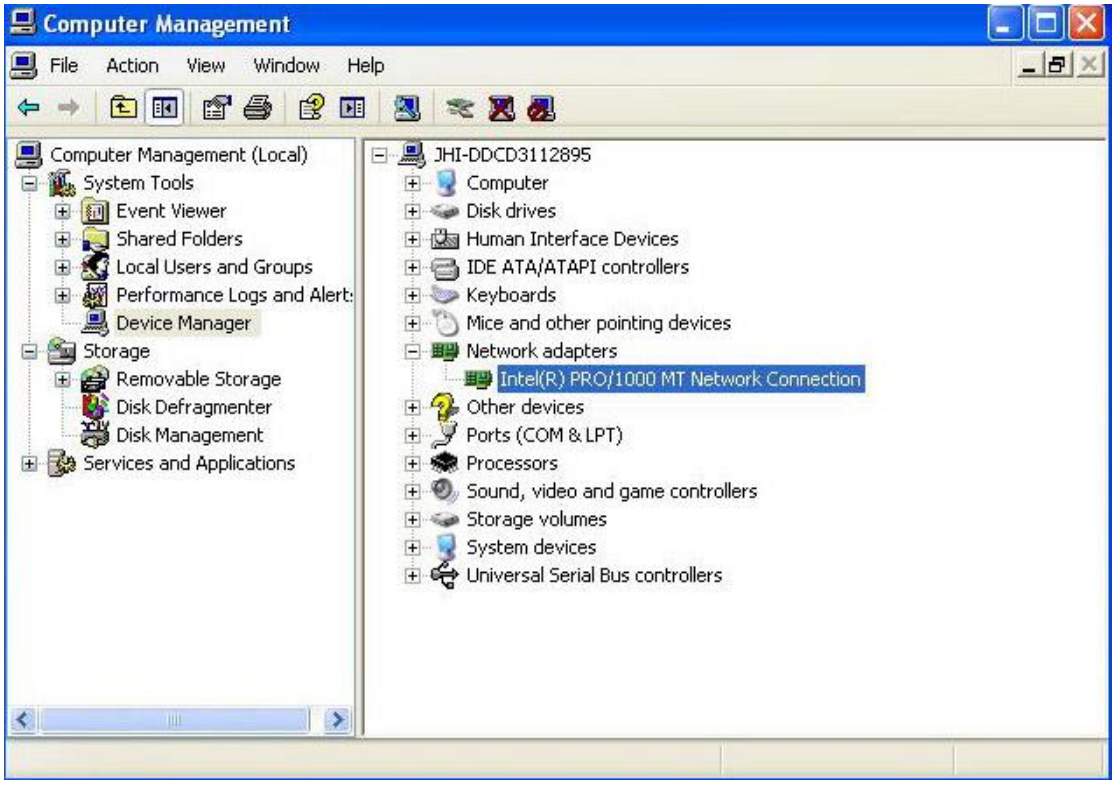


Figure 4-3 the network adapter driver is installed successfully

4.2 Network adapter configuration

Set network adapter parameters: Select the Gigabit network you want to configure, right-click "Properties" to enter the property interface, and then click "Configuration" to display different interfaces according to the network adapter model. (See Figure 4-4)

In the Advanced tab, select "Transmit Descriptors" and "Receive Descriptors" (Figure 4-5), and set them to 1024 or the maximum they can support. It can be good for network transmission, increase the accuracy of data transmission, and reduce packet loss.

（Note: the settings of " Transmit Descriptors" and " Receive Descriptors" are not required. Some network adapters do not support this parameter setting and cannot set it. In addition, different types of network adapters have different names for this parameter, such as "sending Descriptors" and "receive Descriptors" or "Rx Descriptors" and "Tx Descriptors" and so on）.

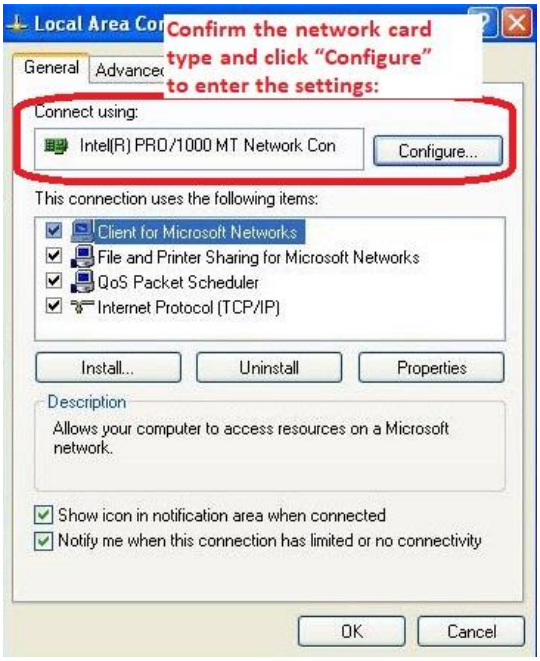


Figure 4-4 Gigabit Network Configuration

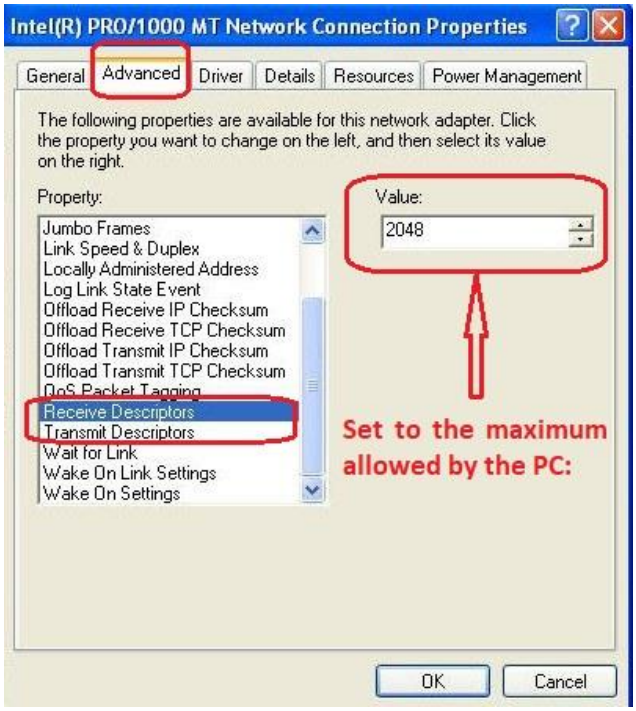


Figure 4-5"Transmit Descriptors" and "Receive Descriptors"

4.3 System setting

1. Gigabit network camera requires gigabit network adapter to work. So please confirm that the Gigabit network adapter is used. The speed of 100M Ethernet network adapter will be limited. The gigabit network adapter drivers should also be installed correctly.
2. Close the system firewall, or add an exception about the firewall to the windows system.

3. Set the network adapter IP: It is recommended that IP address is set to the same network segment (192.168.42.XXX) as the camera. The default of the camera is 192.168.42.234.The network adapter IP cannot be the same as the camera. The setting method is shown in Figure 4-6 and Figure 4-7.

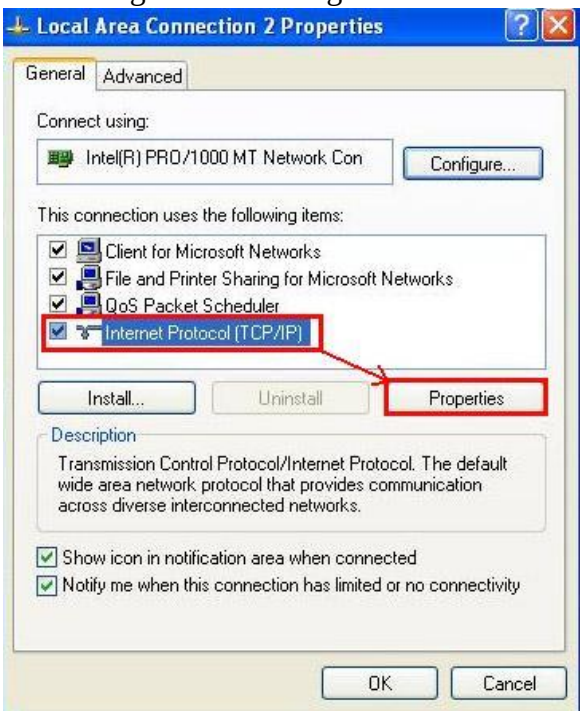


Figure 4-6 select Internet Protocol “TCP/IP”

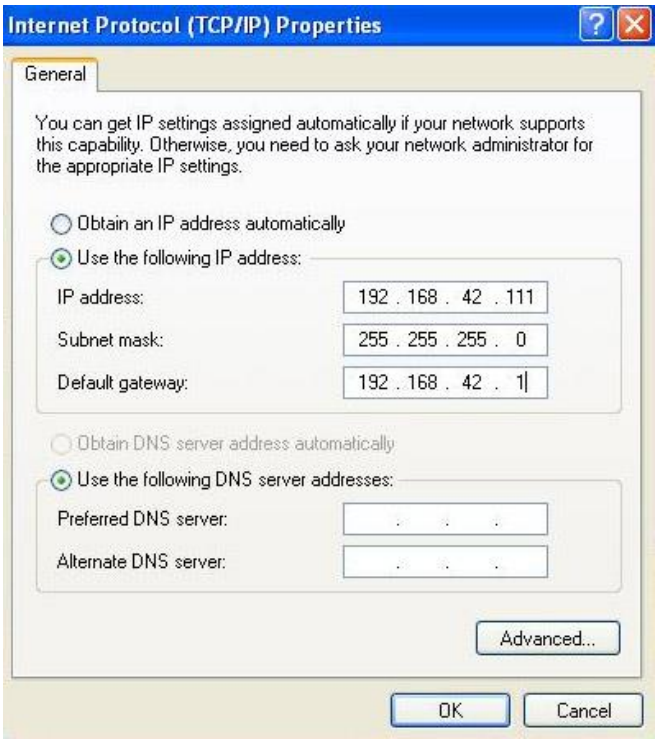


Figure 4-7IP setting

5. Software installation

5.1 Operating environment

GigeDemo and OkDemo can be installed and run in 32 bit or 64 bit versions of operating systems such as Windows NT/2000/XP/Vista/7.

5.2 Install Gige Demo and OK Demo

Run the standard installation program “Setup” in the ok_setup directory of the installation CD (Figure 5-1).

Figure 5-1 setup icon

If the software is installed for the first time, you can easily install the development libraries, drivers and demos at the prompt.

If it is a repair installation, the following dialog box appears, please select "Repair" and then follow the program prompt to install (Figure 5-2).

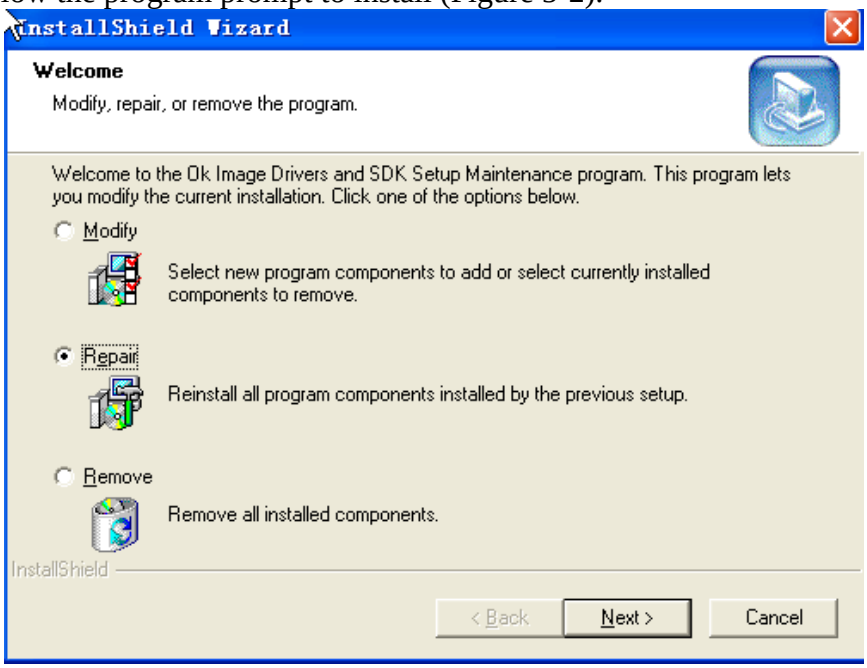


Figure 5-2Installation dialog box

5.3 Buffer allocator

If installing this software for the first time, you need to allocate buffer in PC.
After the demo is installed successfully, the “Ok Image Products” folder is created on the desktop, and the allocation buffer can be made by running “Ok Image

Manager.exe".

Running "Ok Image Manager.exe", the "version information" dialog box appears, and selecting the "Buffer Allocator" in the dialog box(See Figure 5-3). In the "Current status", you can see the size of the frame buffer that the PC has successfully allocated to the OK series image devices from the host memory. The user can allocate the 102400K bytes of buffer in the "New setting", click "OK", and reboot. Each PC machine needs to be allocated buffer only when it is used for the first time.

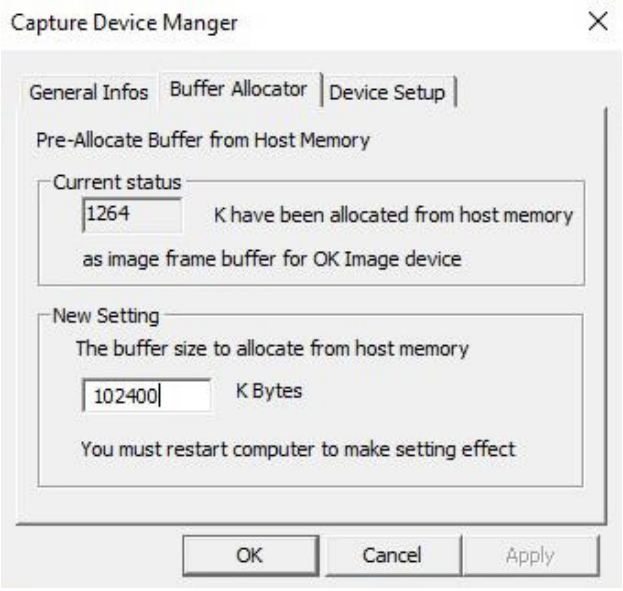


Figure 5-3allocated buffer

After the buffer is allocated, run GigeDemo or OkDemo for image acquisition.

6. Image acquisition and parameter setting

When the software is installed, a folder named "Ok Image Products" is automatically generated under the installation directory. Users can acquire images by "Ok Gige Camera Demo"(In the old version, it named “GigeDemo”) or "OkDemo" in this folder directory. Let's take OK_AM1566 as an example to introduce the use of GigeDemo.

6.1 Software introduction

The interface of GigeDemo is shown in Figure 6-1.

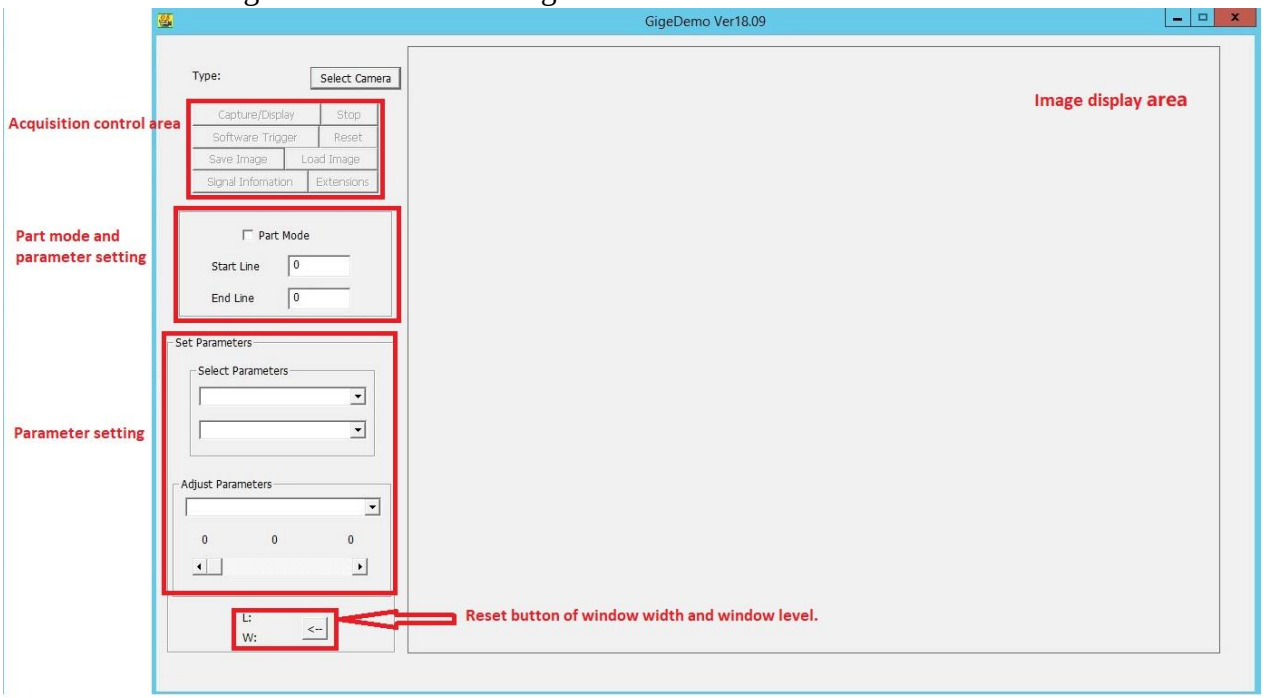


Figure 6-1The interface of GigeDemo

The parameters which the user adjusts by GigeDemo can be automatically stored in memory. When the software is opened again, the parameters are still the modified parameters. If you want to recover the default parameters, please initialize them.

If you need to upgrade the software, please download and upgrade it on our company's website at www.jhi.com.cn.

6.2 Open the camera

Click the "select camera" button on the upper left of the GigeDemo interface, and select the "OK_AM1566" camera (Figure 6-2).

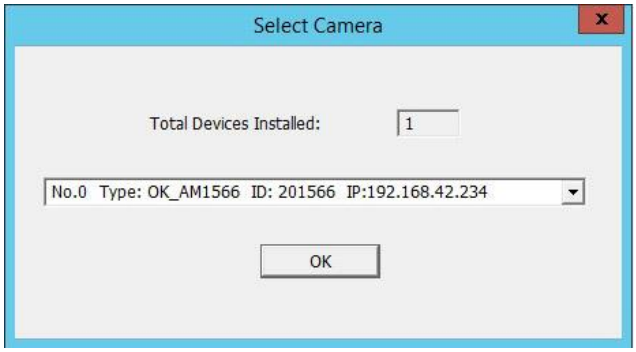


Figure 6-2 Select Camera

6.3 Parameter selection

6.3.1 Pixel format

Pixel Format: Video RGB format and buffered RGB format.（Figure 6-3）。

② **Video RGB format:** Set the depth of image grayscale that is output from camera to PC. For example, gray12 means that the camera can output a 12-bit black-and-white image. At this time, the gray value of the saturated image is 4095. Usually, this gray value is the maximum depth that the camera can output. If the format is lower than the maximum depth, the gray level and detail of the image cannot be fully displayed.

③ **Buffer RGB format:** Set the depth of the image grayscale that is saved in the memory after the camera's image is transmitted to the PC machine. For example, gray12 means that the image cached in PC memory is a 12-bit black-and-white image. At this time, the gray value of the saturated image is 4095.This gray value is usually the same as the video RGB format. If the format is lower than the video RGB format, the gray level and details of the image cannot be fully displayed, if the format is higher than the video RGB format, the low is filled in 0.

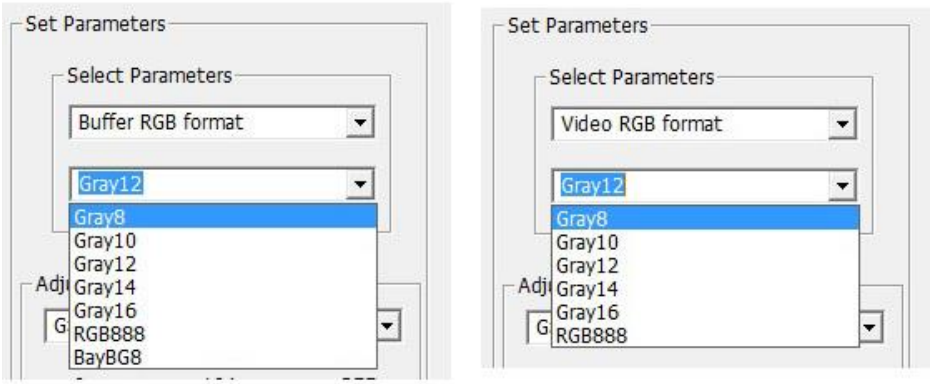


Figure 6-3 Video RGB format and buffered RGB format.

6.3.2 Video mode

In the "Select Parameters" module, you can find the "Video Mode" label, and select the video mode (work mode), such as "Free mode", “Trigger mode", "Pulse trigger mode" (Figure 6-4), to control the camera working state.

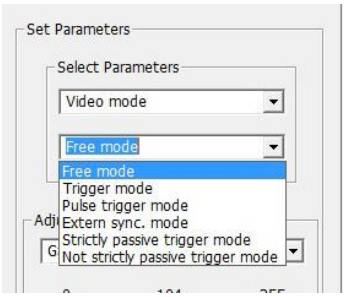


Figure 6-4 the video mode

(1)Free mode

Free mode means that camera periodically and continuously works according to an internal signal. In free mode, camera is in continuous working state, its cycle and exposure time are determined by internal signals. The exposure sequence diagram is shown in Figure 6-5.

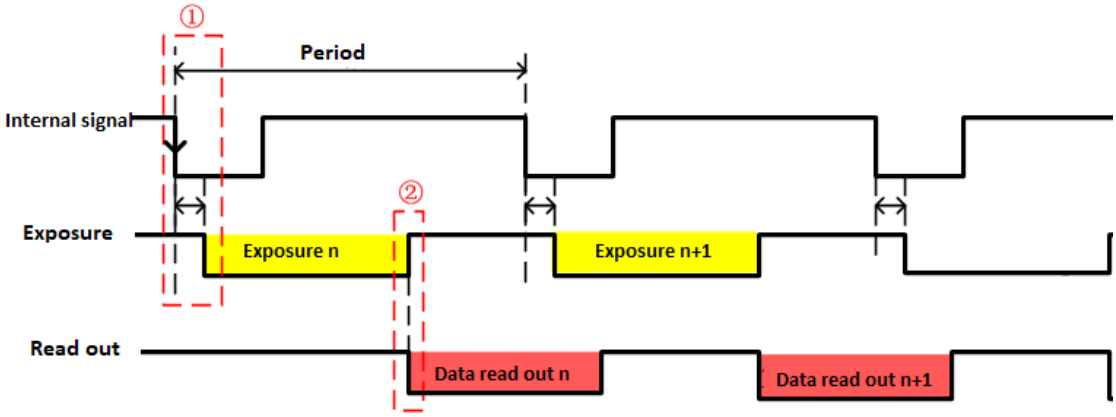


Figure 6-5 the exposure sequence diagram in free mode

In Figure 6-5,

Process①：When the periodic internal signal falls, exposure time starts after delay time (delay time is less than 40μs).

Process②：Exposure ends, the process of readout starts.

Internal signal falls again when the data is read out. This process is cyclical.

（2）Trigger mode

In trigger mode, camera operation process depends on the external trigger signal. Its cycle is related to the external trigger signal. External trigger signal falls, exposure

starts one time. When the camera works in trigger mode, the external trigger signal is the falling edge, and the camera begins to expose. Exposure time is controlled by software. The cycle is equal to the period of the external trigger signal. Its exposure sequence diagram is shown in Figure 6-6.

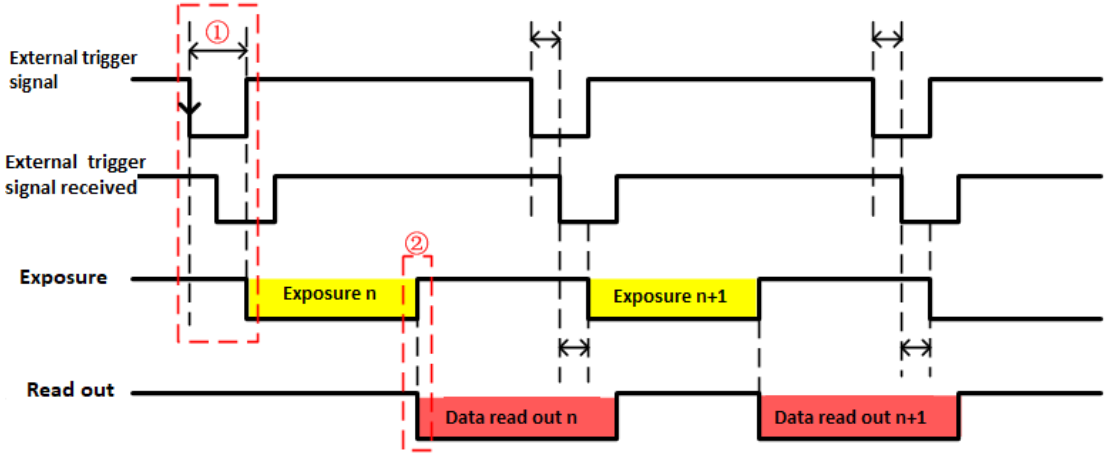


Figure 6-6 exposure sequence diagram in trigger mode

In Figure 6-6,

Process①: When the camera receives an external trigger signal, it produces an internal signal which period is the same as the external trigger signal, and starts exposing. There is also delay time of less than 40μs before exposure.

Process②: Data is transmitted after exposure.

This process is not cycling in this mode. Only when the external trigger signal is received again, the camera starts exposing and readout data.

Time requirement for external trigger signal:

- The external trigger signal is negative pulse.;
- Negative pulse width of the external trigger signal should not be less than 100μs;
- Positive pulse width of the external trigger signal should not be less than 100μs;
- The frequency of the external trigger signal is less than the maximum frame rate in the free mode.

(3) Pulse trigger mode

The exposure time and cycle of the camera are determined by the external trigger signal when the exposure is controlled by the external trigger level. The external trigger signal is the falling edge, and the camera starts to expose. The exposure time is

equal to the low level time of the external trigger signal.The cycle is the external trigger signal cycle, and the exposure sequence diagram is shown in Figure 6-7.

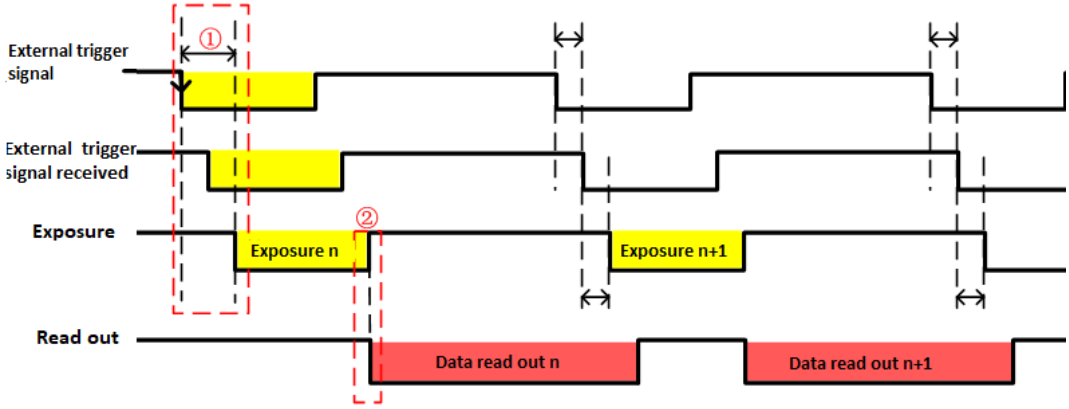


Figure 6-7 exposure sequence diagram in pulse trigger mode

The sequential process of pulse trigger is the same as the external trigger mode, but the exposure time is equal to the pulse width of the external trigger signal. There is also a delay time of less than 40μs before exposure. The same color in the picture shows the same pulse width.

The requirement of trigger signal in Pulse trigger mode is the same as the trigger mode.

6.3.3 Filter

In the "Select Parameters" module, “Optical filter switch” can turn on and off the filter (Figure 6-8).

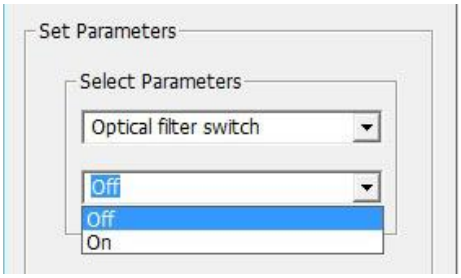


Figure 6-8 Filter switch

6.3.4 GAMMA

There is a default coefficient of the GAMMA correction in camera. When “GAMMA switch” is turned on, GAMMA correction coefficient is set to default value. See Figure.6-9.

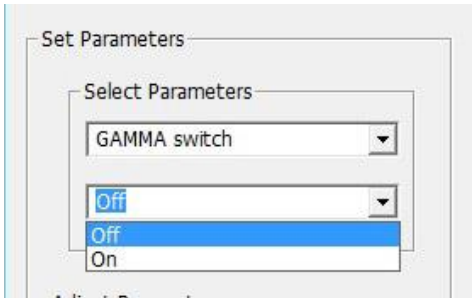


Figure.6-9GAMMA switch

Select "GAMMA value" in the "Adjust parameters" below the "Select parameters", It can be adjusted within the scope of “0<gamma<2” (Figure 6-10). When the coefficient is less than 1, the image brightens, and the smaller the coefficient, the brighter the image; when the coefficient is more than 1, the bigger the coefficient, the darker the image.

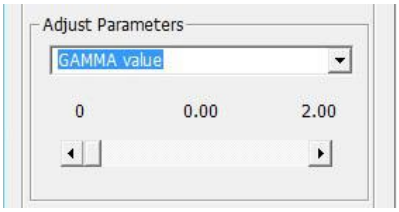


Figure 6-10 GAMMA

6.3.5 Frame frequency mode

Select “Hardware half frame rate mode” in “Settings Parameters”, you can see that OK_AM1566 currently supports “Whole frequency” and “1/2 frequency” modes (Figure 6-11).
If the user needs longer exposure time, half frame mode can be used.

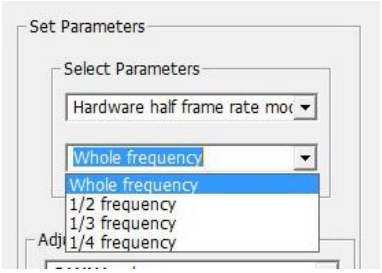


Figure 6-11Hardware half frame mode

6.4 Parameter adjustment

6.4.1 Gain

Set the camera’s gain (Figure 6-12).

- The gain is the magnification of analog signals outputted by CCD before ADC conversion. That is amplifying or reducing the amplitude of analog signals. If the

gain is increased, ADC can make full use of the analog signals of CCD output in the range, but noise will also increase. This needs to find a balance.

The gain range is from 0 to 255 (this parameter is "contrast" in OK Demo). The larger the gain, the greater the amplitude of analog signal that is converted by A/C in ADC. That is the original analog signal multiplied by a multiple.

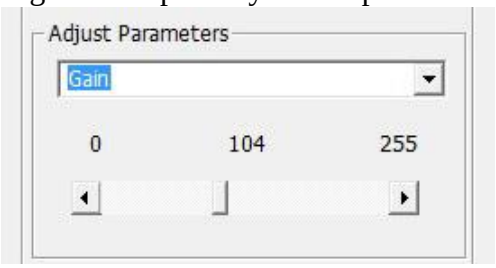


Figure 6-12 Gain adjustment

The relationship between gain parameters on software and actual image gain is shown in Table 6-1.

Table 6-1the relationship between gain on software and actual image gain

Gain range on software	Actual image gain (dB)
0-127	$G(dB)=20\log_{10}([164.5+Gain]/[164.5-Gain])-0.4$
128-255	G(dB)=0.1416Gain-0.04

G (dB) is actual image gain; Gain is the "total gain" value of Gigedemo software.

For example, if the gain value of the software is set to 0, the image gain is actually -0.5dB, approximately 0.95 times larger. Because image gain multiplier and dB value have the following relations: GdB = 20*logG （G is image gain multiplier），

Therefore the actual image gain multiplier G and the Gain of Gigedemo have exponential relationship.

Generally, the optimum gain range of OK_AM1566 is between 60 and 160. When the gain is low, the amplification is small; the gray value of the image is low. When the gain is large, the noise will increase. If the gain is too large, the image is easy to be saturated.

6.4.2 Black level

As shown in Figure 6-13, the "black level" range of camera is from 0 to 255 (in OK Demo, this parameter is "brightness").

- **Black level** can adjust the overall brightness of an image. That is to say, the overall brightness baseline of an image is raised or lowered, or Analog signals that are converted by A/C in ADC increase or decrease a DC level. If the black level is 0, the overall brightness of the image is the darkest. If the black level is 255, and the overall brightness of the image is the brightest.

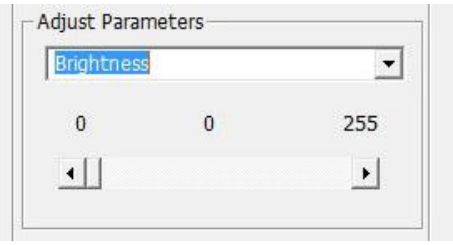


Figure 6-13 black level

- **We recommend that the black level of OK_AM1566 be set to 0.**

6.4.3 Height and width of the image

At the parameter adjustment interface, users can choose the "width of the image" and" height of the image".

- The "width of the image" and" height of the image" can adjust the pixel height and width of the image according to user's needs.

Height and width of the image range is from 1 to 1024. Users can set the image size according to the capture needs.

6.4.4 Exposure time

Set the camera's "exposure time" (range: 0-83333 microseconds) (See Figure 6-14).

① **Exposure time** is the integral time of the CCD sensor in the camera. It is necessary to ensure that X-Ray for camera reaches a stable peak in the integral time. Otherwise, when X-Ray is in the rising or falling, the image captured will be inhomogeneous or the dose of X-Ray will not be enough.

In the free mode, the default exposure time of OK_AM1566 is 40ms.

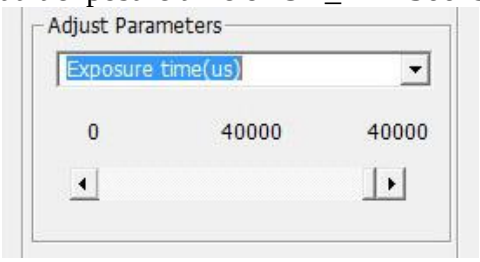


Figure 6-14 exposure time

6.4.5 Packet interval

The proper packet interval should be selected according to the PC environment. The packet interval is usually 1.

② The camera can transmit images normally by the proper packet interval. If the packet interval is too small, it may lead to packet loss or frame loss; if the packet interval is too large, the frame rate of the camera will slow down.

Set the camera's "packet interval" (range: 1-10000) (See Figure 6-15).

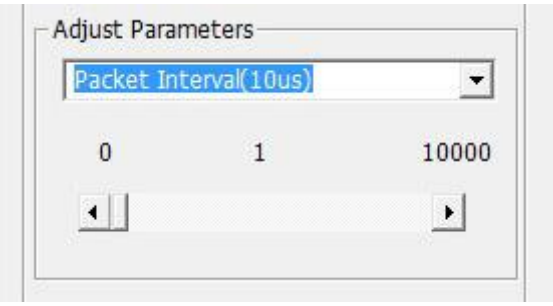


Figure 6-15 packet intervals

6.4.6 Aperture

This camera can provide users with aperture control of 15 levels by software (See Figure 6-16).

① When X-ray is converted into visible light by image intensifier, the aperture can adjust the amount of light which the visible light enters the CCD target of camera. Theoretically, the bigger the aperture, the better the image. However, with the increase of the aperture value, the image saturation of some parts will be caused by X-ray penetrating the human body at a specific dose, the quantum noise of the X-Ray system will be more obvious. But if the aperture value is too small, there will be too little light entering the CCD target to make full use of the dynamic range of the CCD.

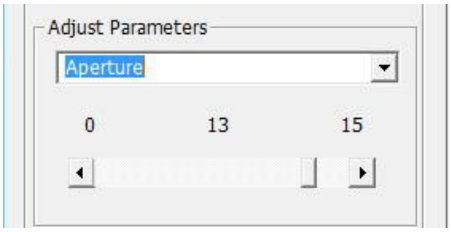


Figure 6-16 apertures

6.4.7 K filter factor

"K filter factor" can be selected 0 to 15 levels (See Figure 6-17).

- **K filter factor** is Inter-frame recursive denoising algorithm implemented by hardware in camera. The coefficient range is 0 to 15, 0 means closed. The bigger the coefficient, the better the noise reduction. But the smear of dynamic images will also be more serious. In order to achieve a balanced

effect, the coefficient is recommended to be 8. This function is just for X-Ray machine.

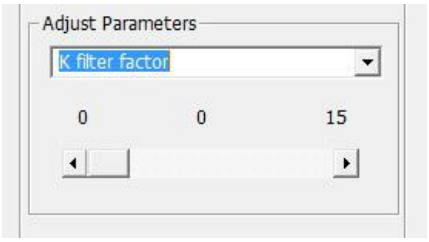


Figure 6-17 the recursive filter coefficient

6.4.8 Smooth filter factor

Users can adjust the "smooth filter factor" by software. Its range is from 0 to 15 levels (Figure 6-18).

- **Smooth filter factor** is inter-frame filtering algorithm implemented by hardware in the camera. The effective factor is from 0 to 2. 0 means closed. The factor is recommended to be 2.

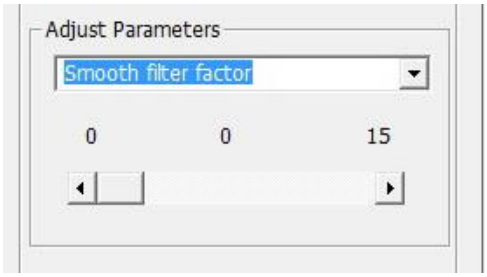


Figure 6-18 the smooth filter factor

6.4.9 Frame rate of plane array camera

If the network is not good enough to transmit the images, users can get low frame rate of images by adjusting the frame rate of plane array camera (See Figure 6-19). So it can reduce the poor image quality caused by network congestion.

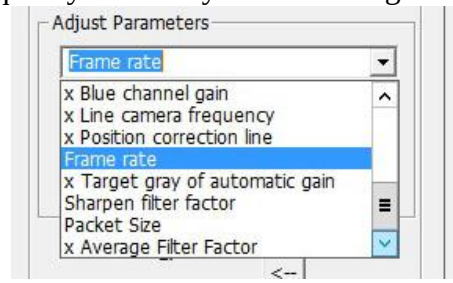


Figure 6-19 frame frequency

The adjustable range of the “frame rate of plane array camera” is related to the “Hardware half frame rate mode”. When the “Hardware half frame rate mode” is "Whole frequency", the “frame rate of plane array camera” can be adjusted from 0 to 25. When the "Hardware half frame rate mode "is "1/2 frequency", the "frame rate of plane array camera" can be adjusted from 0 to 12.

Note: After the user adjusts the "Hardware half frame rate mode", if the "frame rate of plane array camera" also needs to be adjusted, it is suggested to modify the "Hardware half frame rate mode" first, then re-select the camera, and then adjust the "frame rate of plane array camera".

6.5Initialization

If the user needs to restore the factory settings, you can click on the "Reset" (Figure 6-20). After the camera is repowered on, the factory settings can be saved.

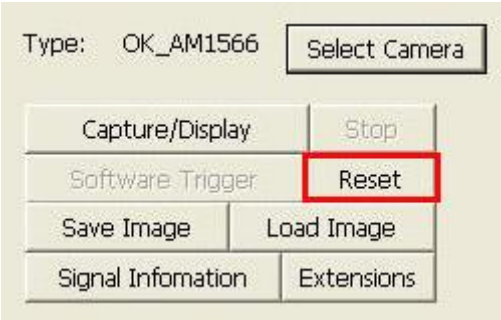


Figure 6-20Reset

7. Troubleshooting

7.1 No image

- Check the power（12V 1.25A）

The red LED of Gigabit network camera is continuous on, which means the power is correct.

If the red light is off, please check whether the power cable is well connected.

- Check the network

1) Confirm whether the light of RJ-45 jack is bright. If not, please check the network cable.
2) Check the IP address. The IP address of the camera should be in the same network segment as the IP address of computer connected to it（The default IP of camera is 192.168.42.234）.
3) Confirm whether Ping the camera successfully in the command prompt. If Ping fails, there may be several reasons:

- The NIC does not work properly. Please reinstall the NIC driver until the device works well.
- If the network cable is not connected, please connect the network cable to another computer to see if it can connect to the local area (wide area) network.
- If the camera does not work properly, please power off first, then power on the camera, and then observe the status of LED light on the camera.

- Confirm whether the camera is transmitting images.

Check the working mode of the camera: it should be “continuous mode”.

7.2 Image transmission stop after a few minutes (or find the camera but no image)

This problem is due to the too small packet interval, the network card cannot be worked for a long time with high capacity. Please increase the packet interval value in GigeDemo or OkDemo.

7.3 Black image

1. Confirm whether the camera has been turned on normally.
Method: No error was prompted when opening OkDemo. In the program interface, the camera model with gray font will be displayed on the right side of "Help".

2. Confirm whether the exposure time of the camera is too short.

3. The cable is too long or the other reason causes too low working voltage.

7.4 Unable to set parameters

See the camera instructions to confirm whether this function is supported; if so, save the factory settings and try again.

7.5 Image quality is not good

（1）Cross stripe: Please check whether there is interference around the camera and whether the camera power is stable.

（2）Noise interference: Reduce the camera gain. If the gain is too high, it is easy to introduce interference. The selection of camera parameters depends on the actual situation.

8. Attentions

1) Do not disassemble the camera without permission.

Please do not disassemble the camera case at will. There are no parts that users can repair themselves or users can adjust. If there is any fault, please contact the manufacturer in time. The maintenance is totally undertaken by the manufacturer.

2) Installation under power off

When power is cut off, users can plug or pull Gigabit Ethernet card and connect system.

When connecting the system, the connectors connecting the two ends of the cable must be connected firmly. If the connection is loose or the Gigabit network card is not plugged in tightly, do not operate when the system is powered on. Please turn off the power first, and then reinstall.

3) Use camera carefully.

Please use the camera correctly, and avoid the collision or vibration of the camera.

4) Don't aim the camera at the strong light.

In any case, the camera should not aim at the bright object (such as the sun) for a long time; otherwise it may damage the CCD image sensor and cause unrecoverable impact on its performance.

5) Do not use this camera under the temperature and humidity conditions which exceed the requirement.

6) Antistatic and ground protection

Camera is an electronic product. We should pay attention to static electricity protection in the process of using it. It is suggested to wear antistatic gloves and take them away.

When the camera is connected to the application system, especially in the

environment of strong electric and magnetic interference, such as high-power motor, machine tools and other equipment, we should pay attention tothe good contact between the ground wire of the equipment and the earth, so as to avoid the abnormal operation or damage of the camera.

9. Maintenance

The camera has a dust-free CCD sensor. Users should try their best to prevent dust from entering the "C/CS" installation ports. When replacing the lens, the "C/CS" installation head should be covered. The camera should be well protected when there is no lens on it.

When cleaning the CCD sensor, special attention should be paid to the following points:

1. Cut off the power before cleaning.
2. Don’t use a dry brush to clean CCD sensor.
3. Use cotton swabs dipped with alcohol or ethane to clean the surface of CCD sensor. When using ethane, please pay attention to ventilation.
4. Use the rubber suction bulb to remove floating dust.

Appendix A OK_AM1566 camera naming and model of image intensifier

Table A-1 model of image intensifier and camera naming

OK_AM1566–AINX 1 2 3 4 5			
1	Model	OK_AM1566	X-Ray GigE camera for SONY sensor
2	image intensifier	A	Class A：Output screen size :20mm； include：Thales23XZ4ST、ThalesTH9428-HP2、TOSHIBA 5764HD-P3、 TOSHIBA 5804HD-P3、Siemens HIDEQ23-3, and so on；
		B	Class B：Output screen size :25mm； include ：ThalesTH9438QX、 TOSHIBA 5830SD-P10A and so on；
		C	Class C：Output screen size :25mm； include ： TOSHIBA 5765HD-P2、 Siemens HIDEQ33-4 and so on；

		O	Basic type X-Ray GigE camera, No adapter and connecting disk；
3	Electric aperture	I	Electric aperture function with steering engine
		O	Electric aperture function with no steering engine；
4	Electric filter	N	Electric filter function with steering engine
		O	Electric filter function with no steering engine
5	Preserved function	X	Preserved function， to be continued.

Appendix B Serial port control

1. Sending serial port instructions

Users can control the adjustment of camera parameters by inputting serial port command in the “serial port debugging assistant” software.

2. Serial port command

Parameters of serial port

1．Serial port：select the COM port that the PC machine can connect to；

2．Baud rate：9600

3．Check bit：Null

4．Data bit：8

5．Stop bit：1

6．Send instructions by sixteen binary.

2.1 Working mode control

1．Free mode

FF AA 12 1B 01 01 00

2．Trigger mode

FF AA 12 1B 01 02 00

3．Pulse trigger mode

FF AA 12 1B 01 12 00

2.2 Gain control

Instructions：FF AA 13 09 02 Byte0 Byte1

Byte0: decimal range is 0 to 63, Byte1: decimal range is 0 to 15, gain = Byte 1*64+Byte 0 (gain range is 0 to 1023).
For example, set the gain to 320 and sending instruction is “FF AA 13 09 02 00 05”.

2.3 Exposure time control

1．Free mode

FF AA 12 23 05 Byte0 Byte1

2．Trigger mode

FF AA 12 23 05 Byte0 Byte1

[Byte1 and Byte0] are exposed time. The decimal range is 0~65536, and the unit is ms.
For example, the exposure time is set to 40ms and the sending instruction is FF AA 12 23 05 28 00.

2.4 Noise reduction and filtering

Instructions：FF AA 12 F5 C0 Byte0 Byte1

Byte0 is a recursive noise reduction coefficient; its decimal range is 0 to 15. 0 means no noise reduction, 15 means the greatest degree of noise reduction.
Byte1is median filter coefficient. 0 means no filter, 1 is common median filter, 2 means Gauss filter。

For example, if the recursive denoising coefficient is the largest and the median filter is used for smoothing, the sending instruction is FF AA 12 F5 C0 0F 01.

2.5 Aperture control

Instructions：FF AA 12 F6 C1 Byte0 Byte1

Byte0 is the aperture position. Byte1 is reserved for 0.The decimal range of Byte0 is 0 to 15. 0 means the aperture completely is closed. 15 means the aperture is opened to the maximum.
For example, the aperture is opened to the maximum and the sending instruction is FF AA 12 F6 C1 0F 00.

2.6 Filter control

FF AA 12 F6 C2Byte0 Byte1
Byte0 is the filter position. Byte1 is reserved to 0. The decimal range of Byte0 is 0 to 15. 0 means the filter is fully opened, that is, the original natural light. 1 means that the filter is open to position 1. At present, only position 0 and 1 are available.
For example, the filter is turned on to position 1, and the sending instruction is FF AA 12 F6 C2 01 00。

2.7 Focus control

FF AA 12 F6 C3Byte0 Byte1
Byte0 is the focus position. Byte1 is reserved to 0.The decimal range of Byte0 is 0 to 15. 0 is the closest focus, that is, the closest field of vision. 15 mean the focus to infinite position.
For example, focus on the infinity position 15 and send the instruction is FF AA 12 F6 C2 0F 00.

Appendix C Image quality adjustment method

There are two working modes for X-ray machine:

① Perspective mode：It is used for human dynamic image perspective to lookup and locates lesions, and the camera works in free running mode.

② Spot mode：After locating the lesion, the patient was photographed and X-ray was output, so that the doctor could further analyze the condition and save it as a medical record. At this time, the camera works in the external trigger mode. the X-ray machine manufacturer decides whether to use the edge trigger mode or the pulse trigger mode：

When the edge trigger mode is used, the exposure time of the CCD sensor is determined by the exposure time parameter inside the camera. When the pulse trigger mode is used, the exposure time of the CCD sensor is determined by the low level duration of the external input signal. The longer the low level duration of the external input signal is, the longer the exposure time is.

The X-ray parameters related to camera image quality are as follows:

(1) The kV value of X-ray output: The larger the KV value, the stronger the X-ray penetration ability. For example, the kV value of human spine is larger than that of lung tissue.

(2) The mA value of X-ray output: It is the X-ray output density. If the mA value increases, the X-ray density increases, and more details can be observed if the radiation per unit area of human tissue is more.

(3) The duration of an X-ray output： In spot mode, the output of X-ray is not continuous, but each output lasts for a certain time, the unit is ms. This parameter can control the low level duration of the external trigger signal transmitted to the camera：When the camera works in the pulse trigger mode, the duration of an X-ray output and the camera exposure time increases. When the camera works in the edge trigger mode, the exposure time of the camera is determined by the setting value inside the camera, therefore, the duration of an X-ray output is longer than the setting value inside the camera.

The three parameters of X-ray determine the image quality at the scene together with the parameters of "exposure time", "gain", "black level" and "aperture" of the camera. The image quality at the scene is mainly evaluated by the following aspects:

1) Image dynamic range: If the multi-level gray scale phantom is observed and adjusted, and all gray levels can be observed at the same time, so the dynamic range has been adjusted to the best.

2) Image resolution：If the requirement cannot be met by observing and adjusting multi-resolution measurement phantom, the focal length of the lens needs to be carefully adjusted to make the image clearest. The higher the resolution, the better the image. For example,

Reference of image quality adjustment:

- Considering the X-ray parameters and camera parameters, the reference value of image quality adjusted at the scene:

	Parameters	Set point
Perspective mode	X-ray(kV)	75kV
	X-ray(mA)	3.2mA
	X-ray duration	null
	Working mode	Free mode
	Electric aperture	8
	Exposure time	33ms
	Gain	170
	Brightness	15
Spot mode	X-ray(kV)	80kV
	X-ray(mA)	320mA
	X-ray duration	4.0ms
	Working mode	Pulse trigger mode
	Electric aperture	4
	Exposure time	null
	Gain	100
	Brightness	22

1. Adjustment principles：

1. The above is the reference value. It is related to the X-ray (KV) and X-ray (mA) required at the scene. For example, if you want X-ray (mA) is less than 320 mA in spot mode, you can increase the X-ray duration. When X-ray (mA) is large in perspective mode, the exposure time of the camera can be reduced.
2. Fix (Fine tuning) some parameters with little flexibility of adjustment. For example, in the spot mode, X-ray (kV) =80kV, aperture =4. The determination of these parameters is based on actual experience and human perspective needs. When the human perspective has requirements for X-ray (kV), the aperture setting is based on the empirical value determined by input X-ray (mA).
3. Excluding the amplification circuit influence of CCD camera. Firstly, setting the low gain of the camera. If the gain of the camera is equal to 100, the critical point

that X-ray intensity (the combination of X-ray (mA) and X-ray duration) makes CCD saturation can be found. We can find the corresponding values of the largest gray scale by adjusting X-ray (mA) and X-ray duration.

2. Adjustment steps：

1. Step 1：Firstly, adjusting the dynamic range of the camera and the dynamic range is debugged according to the set points of the above table. The evaluation criterion of dynamic range is to show that the more level of gray scale phantom is, the better the image is.
2. Step 2：According to the perspective mode and the spot mode respectively to adjust.
3. Step 3：In perspective mode, the camera gain is set to be high: 170.The main adjustment parameters are X-ray (mA), the exposure time of camera, gain and brightness (Fine-tuning).
4. Step 4：In the spot mode, the camera gain is set to be low: 100. The main adjustment parameters are X-ray duration, gain and brightness (Fine-tuning).
5. Step 5：Turn off the image filtering and enhancement of the camera hardware, and turn off the image filtering and enhancement of the application software.
6. Step 6：Carefully adjust the lens focal length, so that the image resolution is the highest and the image is the most clear.
7. Step 7：With image processing effect of the application software, the image filtering of camera hardware can be added as appropriate, if the noise is not large, it is not necessary to add.

Appendix D Support

You can get our technical support in the following ways：

1. Visit our website www.jhi.com.cn to get help from online technical support.
2. Other support
Contact us by telephone (010-51665596), e-mail (info@jhi.com.cn) or fax (010-82629477)
3. Field service
We provide debugging in the field, regular maintenance, troubleshooting and other services in the field to our customers.
4. Product maintenance
OK series of products have implemented the following policies: one year free quality assurance, life-long maintenance.