



**PLD6500A**

**Medical Diagnostic X-ray System**

**User's Manual**

**Nanjing Perlove Medical Equipment Co., Ltd.**

Electrical equipment security type: This product is a kind of permanently mounted common equipment with Class I Type B electric shock protection.

The working system is continuous operation with intermittent loading.

The manufacturer will be liable for security, reliability and performance of the equipment under the following circumstances:

- Assembling, adjustment, operation and maintenance are carry out by authorized personnel;
- Electric utilities in the room are complying with related provisions;
- The equipment is operated in accordance with user's manual.

Packaging, storage and transportation requirements:

The product shall be packaged, stored and transported as per the provisions of YY/T 1099-2007 *Packaging, Transportation and Storage for Medical X-ray Equipment*.

The packaged products shall be adapted to transportation by air, rail, ship and tertiary highways.

The products shall be stored in:

- 1) Temperature:  $-20^{\circ}\text{C}\sim 65^{\circ}\text{C}$
- 2) Relative humidity:  $\leq 93\%$
- 3) Atmospheric pressure:  $50\text{kPa}\sim 106\text{kPa}$
- 4) Indoor environment with no corrosive gas
- 5) Articles exceeding 30kg shall not be stacked on the packing case.

**Dear customer:**

Firstly, we would express our gratitude to you and your company to select our products!

Before operating the equipment, please make sure to carefully read the *Product Manual*, especially the following safety precautions, for you to operate this equipment correctly.

- Please carefully read the following precautions for correct operation of the equipments.
- Before using the equipment, please make sure to get fully known about the performance and operation of it.
- Pay attention to the following matters for setup and storage place of the equipment:
  - No using or storing in place with inflammables and explosives;
  - No using or storing in place temperature, humidity and pressure exceeding permitted ranges;
  - No using or storing in place easy to be dampened;
  - Avoid tilt, shake and shock (including transportation);
  - Pay attention to power supply frequency and voltage as well as allowable current;
  - Keep ventilation and avoid direct sunlight.
- Pay attention to the following matters before using the equipment:
  - Electromagnetic emission and electromagnetic immunity of the equipment shall meet requirements specified in YY0505-2012(idt IEC 60601).The equipment may be operated under typical health care environment specified in YY0505-2012(idt IEC 60601);
  - Confirm power supply connection with the equipment and check if the equipment operates normally;
  - Confirm well grounding of the equipment;
  - Reconfirm the power supply voltage.
  - In case of equipment failure, instead of disassembling, please paste a note written with “Break down!” on the equipment, and the Company will assign authorized personnel for trouble removal.
- No refitting the equipment.

- Maintenance and inspection:
  - Regular inspection the equipment and components;
  - Before reusing the equipment after a long time out of service, please make sure to confirm if the equipment can operate normally and safely.

The following advisory symbols will be used throughout this manual. Their application and meaning are described below.



*DANGERS ADVISE OF CONDITIONS OR SITUATIONS THAT IF NOT HEDED WILL CAUSE DEATH OR SERIOUS PERSONAL INJURY, AND COULD CAUSE PART OR ALL OF DAMAGE OF THE EQUIPMENT.*



**ADVISE OF CONDITIONS OR SITUATIONS THAT IF NOT HEDED COULD CAUSE PERSONAL INJURY, OR DAMAGE OF EQUIPMENT OR DATA.**



**Advise of conditions or situations that if not heeded could cause misoperation and error action.**



The following Security identity symbols will be used the equipment. Their meaning are described below.



**Warning: consult the accompanying  
Documentation**



**Ionizing radiation**



**Equipment with Type-B applied parts**



**Dangerous voltage**



**Ground-fault protection**



**Some components contain material and liquid  
That, at the end of the equipment life-cycle, must  
be disposed of at the recycling centers appointed by the local  
Health Units**



---



---

## TABLE OF CONTENTS

CHAPTER1 OVERVIEW .....	1
1.1 Application of the equipment .....	1
1.2 Main structure and feature of the equipment .....	1
1.3 Daily X-ray Tube Preheating Process .....	3
1.4 Generator Busy Limit Value .....	3
1.5 Standards and Specifications .....	4
1.6 Quality Assurance .....	5
1.6.1 Responsibilities of Manufacturer .....	5
1.6.2 Guarantees .....	5
1.7 Safety Aspects and Attentions .....	6
1.7.1 General Rules .....	6
1.7.2 Electrical Safety .....	6
1.7.3 X-ray Safety Protection .....	7
1.7.4 The Effective Occupation .....	7
1.7.5 Environmental Risks and Treatment .....	8
1.7.6 Retirement of Equipment .....	8
1.8 Use logo identity .....	9
1.8.1 External label .....	10
1.8.2 Equipment nameplate location .....	13
1.9 Transportation and storage environment constraints .....	13
CHAPTER2 TECHNICAL PARAMETERS .....	14
2.1 X-ray high voltage generator .....	14
2.2 X-ray tube assembly .....	14
2.3 Collimator .....	19
2.4 Radiography table .....	20
2.5 Vertical bucky stand .....	20
2.6 Flat-panel detector .....	21

---

2.7 Loading Factor Combination .....	22
2.8 Earth leakage current .....	23
CHAPTER3 PRE-INSTALLATION .....	24
3.1 The room requirements and Layouts .....	24
3.2 Electrical requirements .....	25
3.3 Environmental conditions .....	26
CHAPTER4 INSTALLATION OF THE EQUIPMENT .....	27
4.1 Overview .....	27
4.2 Radiography table installation .....	27
4.2.1 Position of the rail and the table base .....	27
4.2.2 Installation of the tube stand .....	28
4.2.3 The installation of X-ray source assembly .....	28
4.2.4 Installation of counter weight .....	29
4.2.5 Installation of the detector and AEC ionization chamber (optional) .....	31
4.3 Installation of Vertical Bucky Stand .....	31
4.3.1. Positioning of the base .....	31
4.3.2 Installation of detector and filter grid .....	32
4.4 Cable connections .....	33
4.4.1 Power cables and protective ground wire connection .....	33
4.4.2 High voltage generator cables connection .....	34
4.4.3 Console Panel cable connection .....	35
4.5 Final Check .....	36
CHAPTER5 CALIBRATION OF THE EQUIPMENT .....	37
5.1 Calibration of radiography table .....	37
5.1.1 Electromagnet adjustment .....	37
5.1.2 Commissioning of ball pipe lifting .....	40
5.1.3 Commissioning of bed surface lifting .....	41
5.2 Data Calibration .....	41

---

5.3 Commissioning of the chest film frame .....	51
5.4 Software Installation of image Acquisition Workstation .....	52
5.4.1 DR Software Installation .....	52
5.5 Software Setting of Image Acquisition Workstation .....	55
5.5.1 Software Setting .....	55
5.5.2 Workstation IP Settings .....	55
5.5.3 Router Settings .....	57
5.6 Calibration of Generator .....	58
5.6.1 Enter and Debug the High Voltage Generator .....	58
5.6.2 Software Interface .....	58
5.6.3 SDK Service Mode Interface .....	60
5.6.4 Final Inspection .....	68
5.7 X-ray and Image Adjustment .....	69
5.7.1 X-ray Adjustment .....	69
5.7.2 Collimator Adjustment .....	70
5.7.3 Flat Panel Detector Adjustment .....	70
5.8 AEC Calibration .....	74
5.9 Final Confirmation Inspection .....	76
CHAPTER6 OPERATION OF THE EQUIPMENT .....	77
6.1 The Description of the Symbol on the Device .....	77
6.1.1 Generator Operation Panel and Symbol Description .....	78
6.1.2 Radiography Table Operation Panel and Symbol Description .....	79
6.1.3 Operation Description of the Collimator .....	81
6.1.4 Intercom System Instruction .....	82
6.1.5 Operation Instruction of Workstation .....	83
6.2 Use of Equipment - Digital Radiography Mode .....	121
6.2.1 Filter Line Device DR Radiography .....	121
6.2.2 Chest DR Radiography .....	121

---

6.2.3 Initial RUN-UP .....	121
CHAPTER7 COMMON FAULTS AND TROUBLESHOOTING .....	122
7.1 Fault Code and Troubleshooting .....	122
7.1.1. HV Generator .....	122
CHAPTER8 MAINTENANCE .....	125
8.1 Maintenance by Operator .....	125
8.2 Maintenance by the Autholiftd Technician .....	127
8.3 The Cycle of Maintenance and Repair .....	128
CHAPTER9 ATTACHMENT .....	130

## CHAPTER1 OVERVIEW

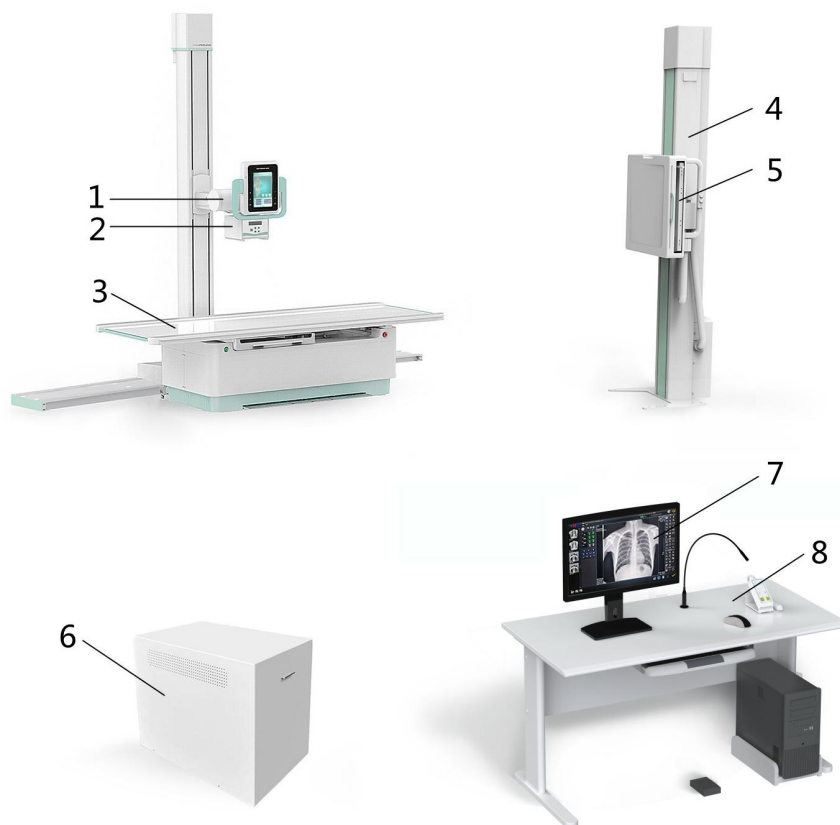
### 1.1 Application of the equipment

It is used for routine radiography of patients to obtain a single image for clinical diagnosis.

**Contraindications:** incompatible patients, pregnant women and lactation women, children, infants, and critically ill patients are not suitable.

### 1.2 Main structure and feature of the equipment

This equipment mainly consists of radiographic table, Tube stand & ground rail, high-frequency and high-voltage generator, operating console, X-ray tube assembly, Collimator(manual), vertical Bucky stand, Image workstation, LCD Display see Figure 1-1.



1-X-ray tube assembly 2-Collimator(manual) 3-Radiographic table

4-Ground rail for Tube stand 5-Vertical Bucky stand 6-High-frequency and high-voltage generator

7-Image workstation 8-Console

Figure 1-1

---

**Main Features:**

## 1. Generator

- High frequency high voltage generator with maximum output power of 65 kW.
- Output 150 kV voltage.
- Adopt a smaller, lighter modular design.
- In the process of exposure, the constant radiation output can be achieved through adjusting kV and mA.
- Operator can modify APR technical term.
- A variety of automatic diagnostic procedures, and prompt information to the operator.

## 2. Flat Panel Detector

- Contains 3072\*3072 active pixel matrices with pixel size of 139um .
- 17×17-inch large-sized flat detector, which can completely cover the full belly and full chest, allows the shooting without any restrictions.
- Fast direct imaging speed, perfect combination with DR acquisition software, greatly improving system efficiency.
- Amorphous silicon has stable performance and low requirement of environmental temperature. No irreversible damage caused by crystallization in high-temperature environment.

## 3. Powerful image system

- One button setting exposure conditions and acquisition protocol, greatly improving the patient pass rate and work efficiency.
- Parallel image processing and symphonic multi-channel filtering equalization technology can shorten imaging time and improve imaging quality.
- Open collection and background curve to meet the personalized diagnostic needs of different specialized hospitals.
- Rich and complete image processing and measurement system, and provide abundant clinical diagnostic tools.
- Comprehensive DICOM support and network connection processing functions to meet the needs of digital expansion of the system.
- Fully comply with the latest DICOM3.0 standards, compatible with DICOM-WORKLIST, and realize all applications such as patient management/image management/transmission/display/archive/print/CD burning, etc.
- Provide static and dynamic image output based on WINDOWS format for easy browsing.



---

#### 4. Radiography table

- Intuitive and interactive human-machine interface, patient information, radiography site, SID, tube rotation Angle, collimator opening value can be displayed directly, high pressure exposure parameters, patient body type can be directly adjusted on the cow head assembly, convenient, intuitive and easy to understand.
- 6) Wide range of tabletop movement, can easily complete a variety of position radiography
- 7) The tube can rotate  $+180^{\circ} \sim -180^{\circ}$  along the column to facilitate stretcher radiography for patients with limited mobility
- 8) Tube rotation range of  $+90^{\circ} \sim 0^{\circ} \sim -90^{\circ}$ , can be used for a variety of special position radiography
- 9) With the vertical bucky stand, it can fully meet the needs of the radiographic examination of all parts of the whole body in general practice, such as standing, lying and frontal side
- 10) High quality plate detector, further improve the image clarity, contrast, easier, clear identification of lesions.

### 1.3 Daily X-ray Tube Preheating Process

Use this process when the generator is turned on for the first time every day or if the device is not used for several hours. Medium power exposure is done before exposure with maximum mA or kV values. This reduces the possibility of damaging the anode and the high pressure components. No test Settings are required. To obtain the best stability and reliability, please select the following technologies at startup: big focus, 80 kV, 200 mAs. One (1) to three (3) exposure is made at intervals of 30 seconds.

### 1.4 Generator Busy Limit Value

Insufficient cooling time between the two rounds may cause excessive heat buildup inside the generator and may cause serious damage to the generator. This X-ray generator has the function of internal monitoring of busy degree and can give warning when excessive heat is accumulated.

## 1.5 Standards and Specifications

GB/T 191—2008	Packaging-pictorial marking for handling of goods
GB 9706.1—2007	Medical electrical equipment Part 1: General requirements for safety (idt IEC 60601-1)
GB 9706.3—2000	Medical electrical equipment Part 2: Particular requirements for the safety of high-voltage generators of diagnostic X-ray generators (idt IEC 60601-2-7)
GB 9706.11—1997	Medical electrical equipment Part 2: Particular requirements for the safety of X-ray source assemblies and X-ray tube assemblies for medical diagnosis (idt IEC 60601-2-28)
GB 9706.12—1997	Medical electrical equipment Part 1: General requirements for safety 3. Collateral standard: General requirements for radiation protection in diagnostic X-ray equipment (idt IEC 601-1-3)
GB 9706.14—1997	Medical electrical equipment Part 2: Particular requirements for the safety of associated equipment requirements of X-ray equipment (idt IEC 601-2-32)
GB 9706.15—2008	Medical electrical equipment Part 1: General Requirements for Safety 1. Collateral standard: Safety requirements for medical electrical systems (idt IEC 60601-1-1)
GB 9969.1	General principles for preparation of instructions for use of industrial products
GB/T 19042.1—2003	Evaluation and routine testing in medical imaging departments - Part 3-1: Acceptance tests - Imaging performance of X-ray equipment for radiographic and radiosopic systems (idt IEC 61223-3-1)
YY 0076—1992	Coating classifications for metal product Technical conditions
YY/T 0291—2016	Environmental requirements and test methods for medical X-ray equipment

---

YY/T0466.1—2009	Medical devices- Symbols to be used with medical device labels, labeling and information to be supplied.
YY/T 0106—2008	General specifications for medical diagnostic X-ray equipment
YY/ T1099-2007	Packaging, transportation and storage for medical X-ray equipment
GB/T10151-2008	Medical X-ray equipment - Specification for high voltage cable plug and socket connections
YY/T 0741-2018	General specifications for digital medical X-ray radiography system
YY 0505-2012	Medical electrical equipment - part 1-2: General Requirements for Safety- parallel standards: electromagnetic compatibility requirements and tests
Command no.6	(The state food and drug administration) : Management regulations for manual and label of medical equipment

## 1.6 Quality Assurance

### 1.6.1 Responsibilities of Manufacturer

The manufacturer will be liable for quality of the equipment in aspects of safety, reliability and performance under the following conditions:

1. Installation, adjustment, modification and maintenance are carried out by personnel of our company or personnel authorized by our company;
2. All electric utilities of the equipment comply with requirements of the Manual;
3. Operators of the equipment are well trained and skilled technical staff and operate strictly in accordance with the Manual.

### 1.6.2 Guarantees

1. Under the precondition that the user complies with above provisions, within one year after delivery, due to any quality problem, the equipment cannot be operated normally, the company will repair or replace spare parts for free, and even accept the return of the

- equipment.
2. Because of the user is not comply with the provisions above, or the equipment exceeded 1 year after delivery, causing damage of the equipment, the company provides maintenance service or replaces spare parts, and pays the fee of the maintenance by the user.
  3. The company provides ordinary maintenance service for the equipment which is operated correctly within 10 years of equipment life-cycle.

## **1.7 Safety Aspects and Attentions**

### **1.7.1 General Rules**

The purpose of the Manual is guiding certified fluorography to operate the equipment safely. As radioactive equipment, this equipment will be operated strictly according to provisions of the Manual and cannot be used for other purpose except medical radiography. This equipment can only be used by trained personnel with needed radiation knowledge. Special attention will be paid on the following matters during using:

1. It is not allowed to use the equipment if it has any electric or mechanical fault.
2. It is not allowed to remove protective circuit or protective device to make the equipment working under power on.
3. It is not allowed to use the equipment under the environment of moist, inflammable and explosive.
4. Consent of our Company or maintenance personnel authorized by the Company shall be obtained from any modification to the equipment.
5. It shall be ensured that replacing components of the equipment will not endanger any patient or operator; where necessary, maintenance personnel of our company may be contacted.
6. Improper operation may result in damage to the equipment; hence regular inspection and maintenance are necessary.
7. The company will be liable for any personal and property losses caused by the equipment, excluding that due to non-compliance to the Manual or modifying the system without authorization.

### **1.7.2 Electrical Safety**

1. Ensure network voltage and current meet requirements of the equipment on power.

2. The equipment shall be put in well-ventilated room without flammable and combustible gas leakage.
3. Cleaning, disinfection and sterilization shall be conducted when the complete machine is power off.
4. If the floor where the high voltage generator locates is not made of wood, the generator shall be put on wood base.
5. Shut off the machine and switch off the power after using.

### **1.7.3 X-ray Safety Protection**

Every time before exposure, it shall be ensured to adopt measures to prevent X-ray and keep in mind the following matters:

1. Wear X-ray protective clothing and X-ray protective goggles for table side work;
2. Operate in compartment to the greatest extent to be far away from X-ray source;
3. Low dose exposure to the greatest extent under permitted projection condition.

### **1.7.4 The Effective Occupation**

The effective occupation area of the radiography table is shown in figure 1-2.

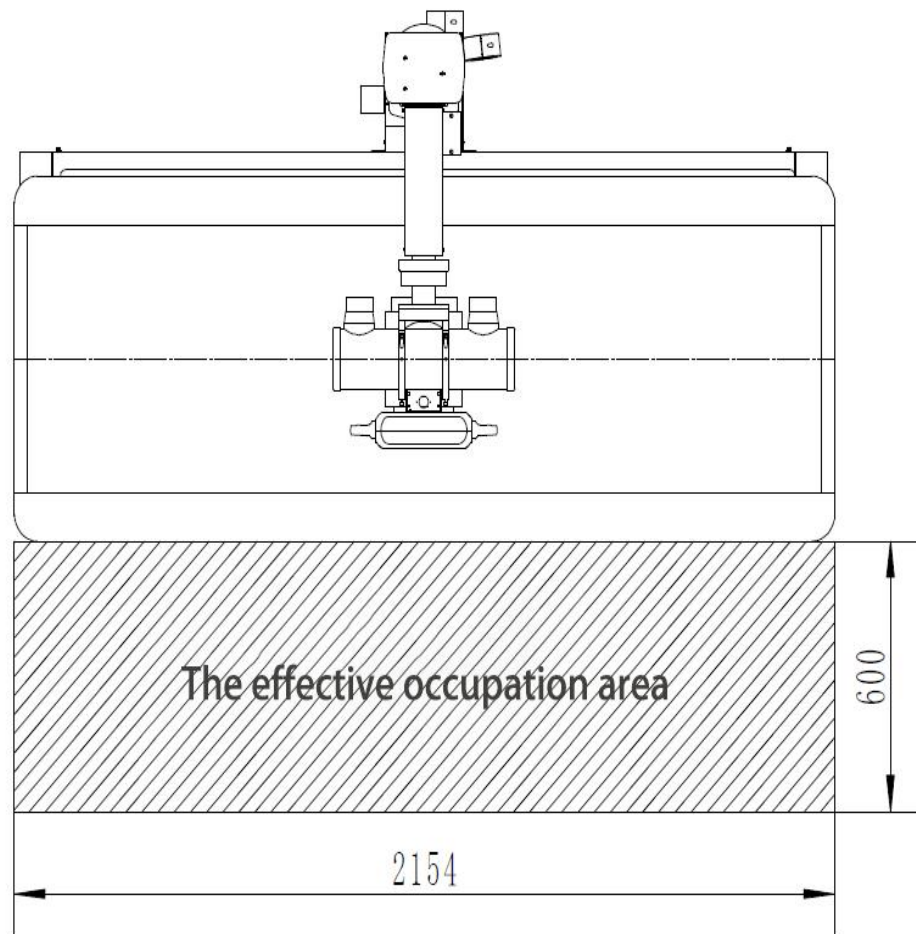


Figure 1-2 Radiography table level a placeholder area effectively

### 1.7.5 Environmental Risks and Treatment

When the equipment is retired, the X-ray tube assembly and transformer oil in high voltage generator shall be reclaimed by specialized industrial waste and waster oil collection station; while other steel and cooper materials shall be reclaimed by corresponding department. In particular, the equipment contains the following materials and/or components:

- **“Reducers”**: lubricating oil, steel, aluminum
- **Motor**: iron, copper, hard plastic material casings
- **Electric cabinet**: iron, aluminum, copper, non-biodegradable plastics, printed circuit board.












### 1.7.6 Retirement of Equipment

The equipment life-cycle is 10 years under the condition of correct using, and the X-ray tube life-cycle is about 100,000 times, the damaged X-ray tube can be sent to our company

for replacement. If the equipment is damaged and it is beyond repair after correct using for 10 years, the equipment shall be retired.

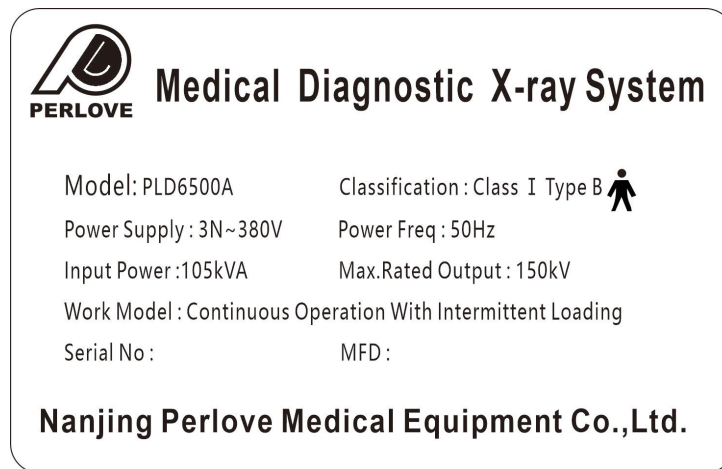
## 1.8 Use logo identity

Symbol description:

	<i>Radiography</i>		<i>Dangerous voltage</i>		<i>Ionizing radiation</i>
	<i>Small focal spot symbol</i>		<i>Type-B equipment</i>		<i>Protective grounding</i>
	<i>Large focal spot symbol</i>		<i>“Speaking” device</i>		<i>“Listening” device</i>
	<i>Talkback conversion</i>		<i>Emergency stop</i>		

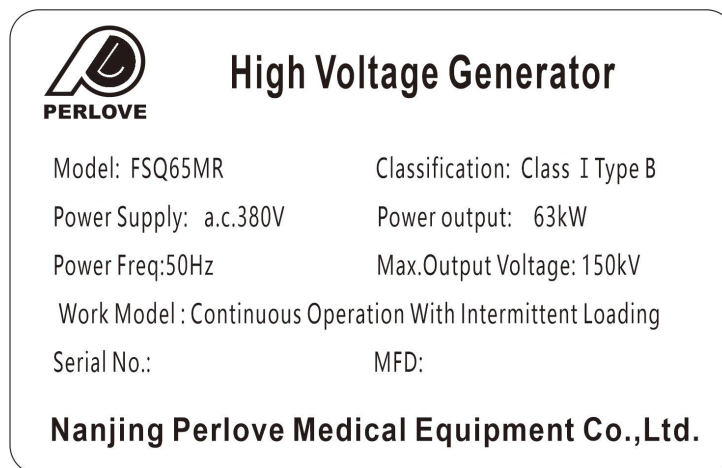
## 1.8.1 External label

### 1. Equipment nameplate



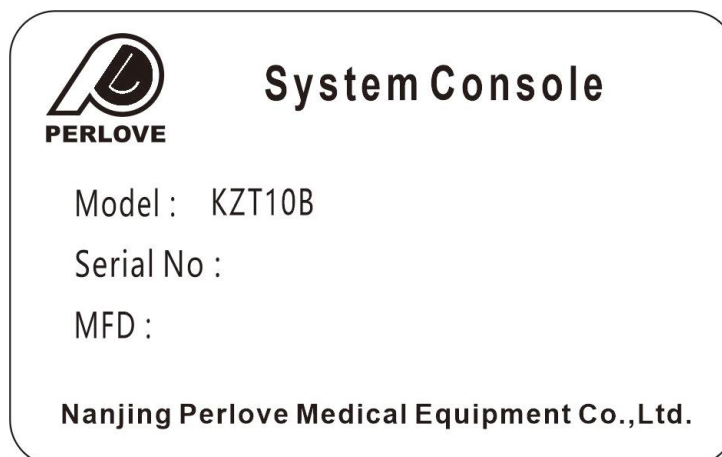
*Figure 1-3*

### 2. High-voltage generator nameplate



*Figure 1-4*

### 3. Console nameplate



*Figure 1-5*



4. Radiography table nameplate

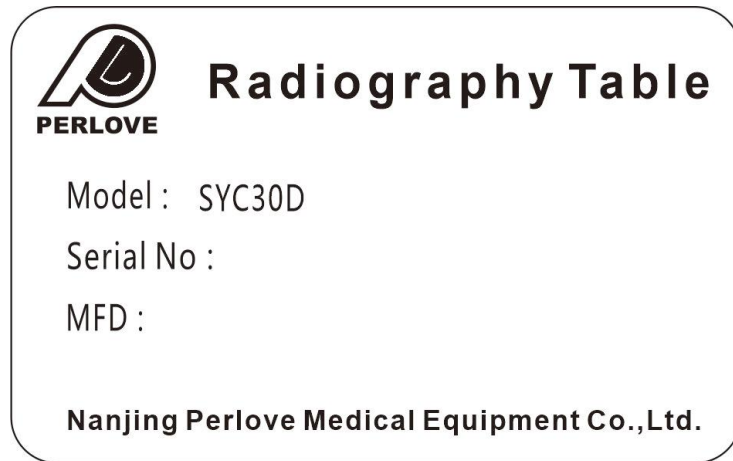


Figure 1-6

5. Collimator nameplate

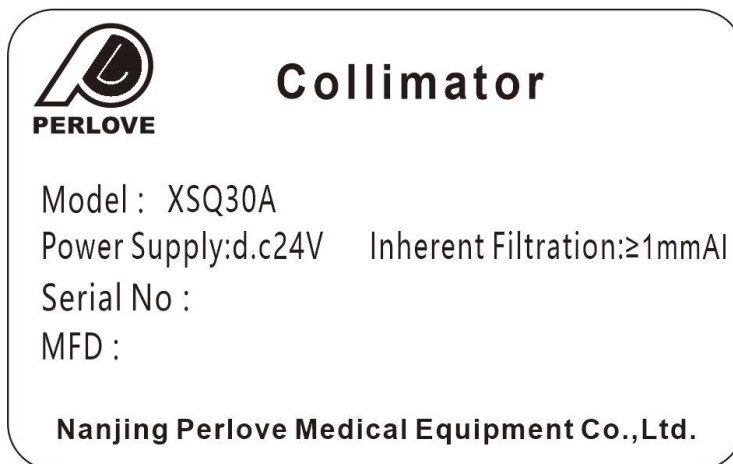


Figure 1-7

6. Vertical bucky stand nameplate

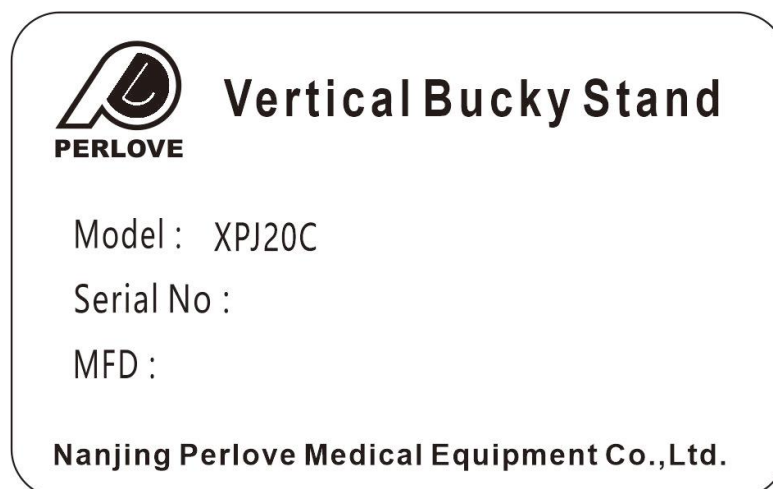


Figure 1-8

## 8. X-ray tube assembly nameplate



Figure 1-9

## 9. DR acquisition workstation nameplate

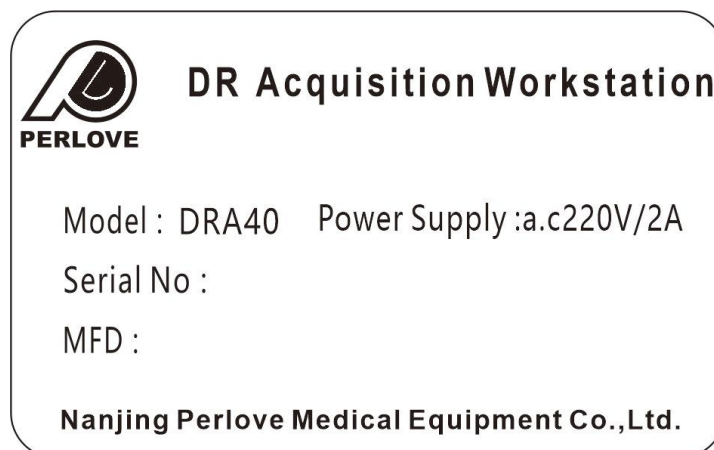


Figure 1-10

## 10. Flat Panel Detector

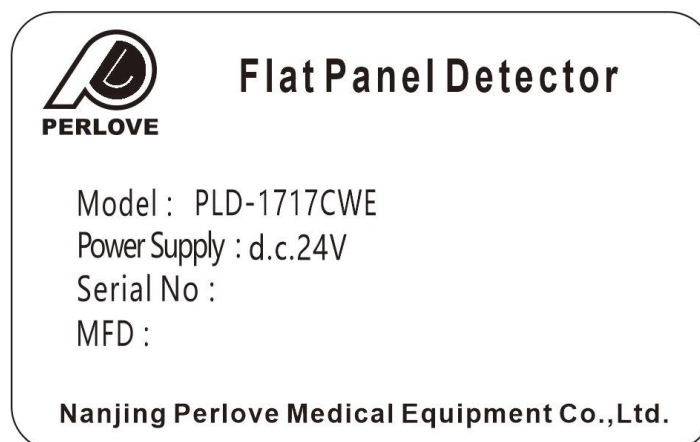


Figure 1-1

## 1.8.2 Equipment nameplate location

The equipment nameplate location is as shown in Figure1-12.

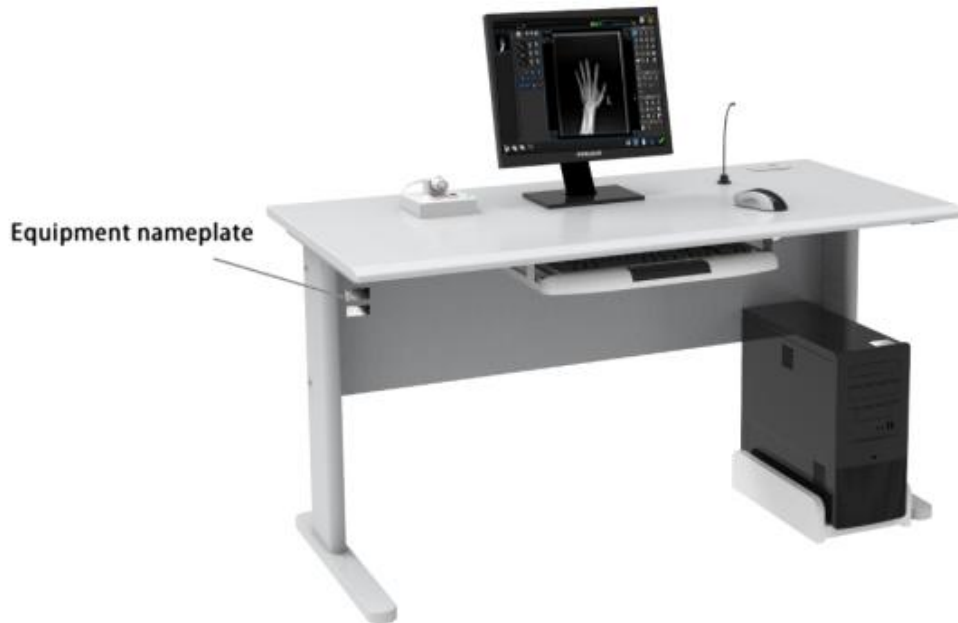


Figure 1-12

## 1.9 Transportation and storage environment constraints

1. The product must be fixed in the process of transport measures, prevent sloshing around a car; The gondola car transport, it must be cover good with mat cloth. Damage to the product, if discover fault or any other questions, please contact with me and show the following situations:

- a) Product model;
- b) Production serial number or date;
- c) Purchase date;
- d) Need to contact problem specific content, such as the failure condition, the point of failure or damage.

2. Transportation and storage conditions

- a) environment temperature:  $-20\sim 65^{\circ}\text{C}$
- b) Relative humidity:  $\leq 93\%$
- c) atmospheric pressure:  $50\sim 106\text{kPa}$

---

## CHAPTER2 TECHNICAL PARAMETERS

### 2.1 X-ray high voltage generator

1. Maximum power: 65.5kW
2. kV range: 40 ~ 150kV
3. mA range: radiography: 10 ~ 800mA
4. mAs range:0.1 ~ 800mAs
5. Time range: radiography: 1 ~ 10000ms

### 2.2 X-ray tube assembly



**Attention:**

- X-ray tube assembly equipped to this equipment (hereinafter referred to as assembly) only applies to medical radiography.

Pay attention to that load exceeding the stipulated condition is not allowed, because overload operation may result in damage to tube sleeve and X-ray tube. The assembly is equipped with normally-closed temperature switch, which will start when wall temperature of the assembly reaches 75°C.

- The assembly will generate X-ray while working under high voltage; therefore attention shall be paid to protect it during operation and adjustment.
- Using the assembly in the environment with inflammable or poisonous gas is not allowed.

The operation environment temperature is 10°C ~ 40°C, relative humidity is 30% ~ 85% and the atmospheric pressure is (70~106)kPa.

As for transportation and storage environment conditions, the temperature range is -20°C ~ 70°C, the relative humidity is 20%~90% and the atmospheric pressure is (50~106)kPa.

- Inside the assembly, there's glass X-ray tube mounted, hence it shall be handled

**gently during transportation and installation to avoid damage to X-ray tube.**

- **As per the national regulations, installation, adjustment and using of the assembly shall be carry out by personnel with professional qualification certificates.**
- 1.Model of X-ray tube assembly: E7252X
- 2.Grade of X-ray tube assembly: Grade I Type B
- 3. Parameters of X-ray tube:
  - X-ray tube model: XH-106V
  - Target material: Molybdenum base rhenium – tungsten composite target
  - Basic shaft involved in target angle and focal spot of X-ray tube: the straight line perpendicular to shaft axis of X-ray tube and passing through window mark point.
  - Anode target face angle of X-ray tube: 12°
  - Nominal focal spot value: Large focal spot: 1.2mm; small focal spot: 0.6mm
  - Tolerance of focal spot center of X-ray tube to basic shaft: <1.5mm
  - Maximum operation tube voltage: Fluoroscopy: 125kV Max; exposure: 150kV Max
  - Maximum anode input power: Large focal spot:75kW; small focal spot: 27kW
  - Maximum anode thermal capacity: 210KJ
  - Filament volt-ampere characteristics of X-ray tube:
    - Large focal spot (5.5A): AC 12.7~ 17.1V
    - Small focal spot (5.2A): AC 7.0 ~ 9.4V
  - Filament frequency limit of X-ray tube: 0~25 kHz
  - Inherent filtration of X-ray tube: 0.9 mmAl/75kV
  - Anode rotate speed of X-ray tube: 50Hz: 2700rpm; 60Hz: 3200rpm;180Hz: 9700rpm
  - Maximum anode heating power of X-ray tube: 475W (667HU/s)

- 4. Motor Ratings:

Item	Starting	Running
Power frequency (Hz)	180	180
Voltage (V)	460	130
Min acceleration time (S)	1.0	—
Phase-splitting electric capacity( $\mu$ F)	3	3

- 5. Insulation resistance of stator between outgoing line and tube case: 2M $\Omega$  (Min)
- 6. Total filtration of assembly:  $\geq$ 1.9 mmAl (75kV)

- 7. Radiation protection of the assembly shall meet GB9706.12 III. General Requirements on Radiation Protection of X-ray Diagnosis Equipment of Part I: General Safety Requirements of Medical Electric Device (idt IEC601-1-3), i.e. 150kV 3.4mA.
- 8. Radiation field of assembly: when SID1000mm, 430mm×430mm
- 9. Assembly weight (approximate): 18kg
- 10. High voltage cable interface of the assembly shall comply with IEC 60526.
- 11. Cooling medium: transformer oil with temperature  $\leq 75^{\circ}\text{C}$
- 12. Cooling method of assembly: natural cooling
- 13. Thermal capacity of assembly: 900kJ (1250kHU)
- 14. Max. cooling velocity of assembly (natural cooling): 200W (16kHU/min)
- 15. Refer to Figure2- 1 for emission characteristics of X-ray tube.

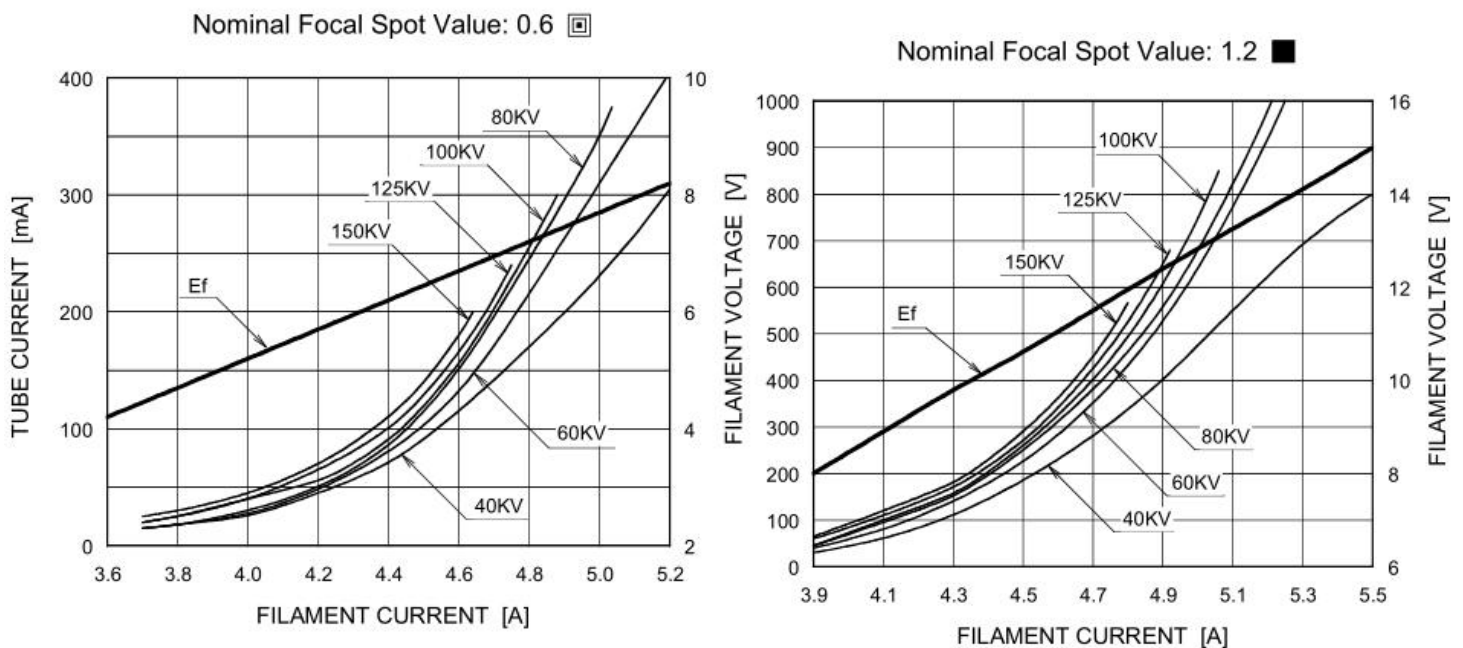


Figure 2-1 Filament emission characteristics of X-ray tube

- 16. Refer to Figure2- 2 for load characteristics of X-ray tube.

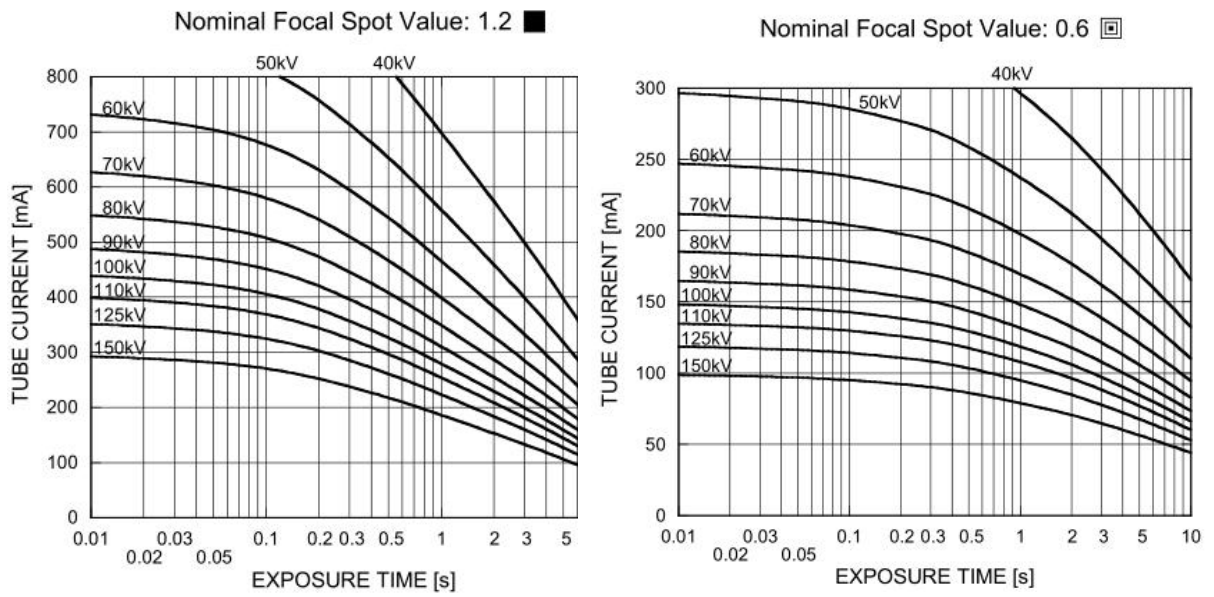


Figure 2-2 Load characteristics curve (three-phase 50Hz)

- 17. Refer to Figure 2-3 for anode thermal characteristics of X-ray tube.

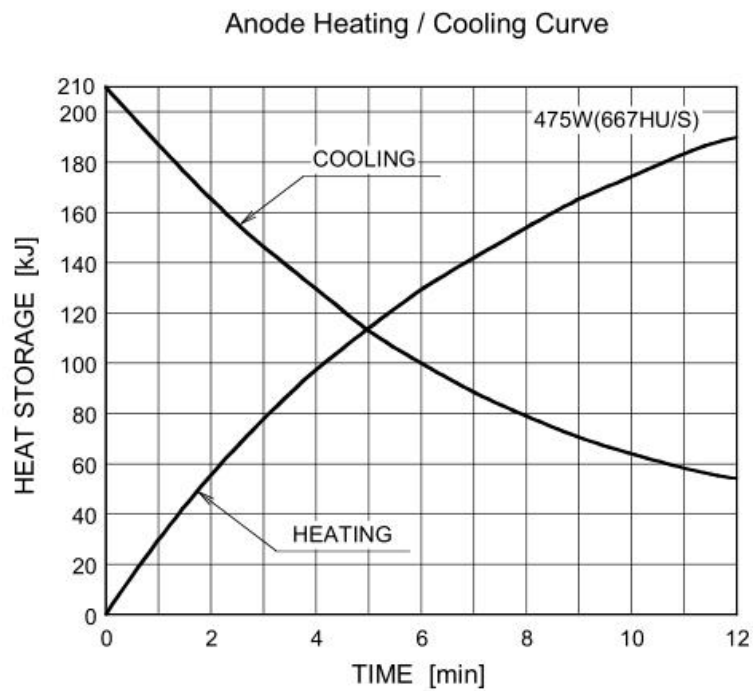


Figure 2-3 Anode thermal characteristics of X-ray tube

- 18. Refer to **Figure 2-4** for cooling characteristics of assembly.

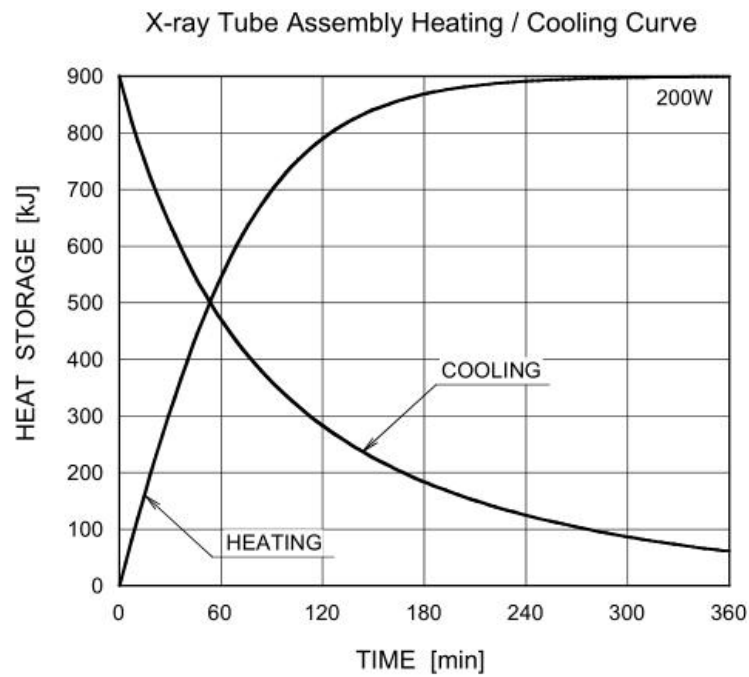


Figure 2-4 Thermal characteristics of X-ray tube assembly

- 19. Refer to **Figure 2-5** for anode plate wiring of assembly.

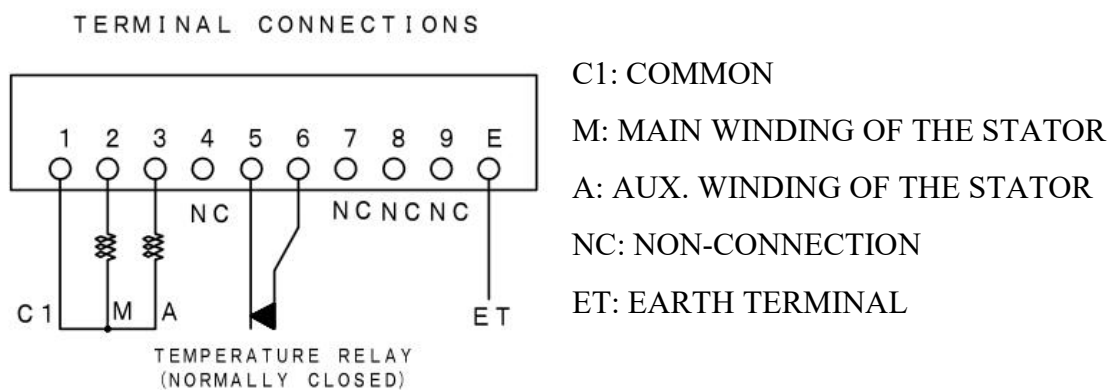


Figure 2-5 Anode terminal wiring diagram

- 20. Refer to Figure 2-6 for overall dimensions of assembly.



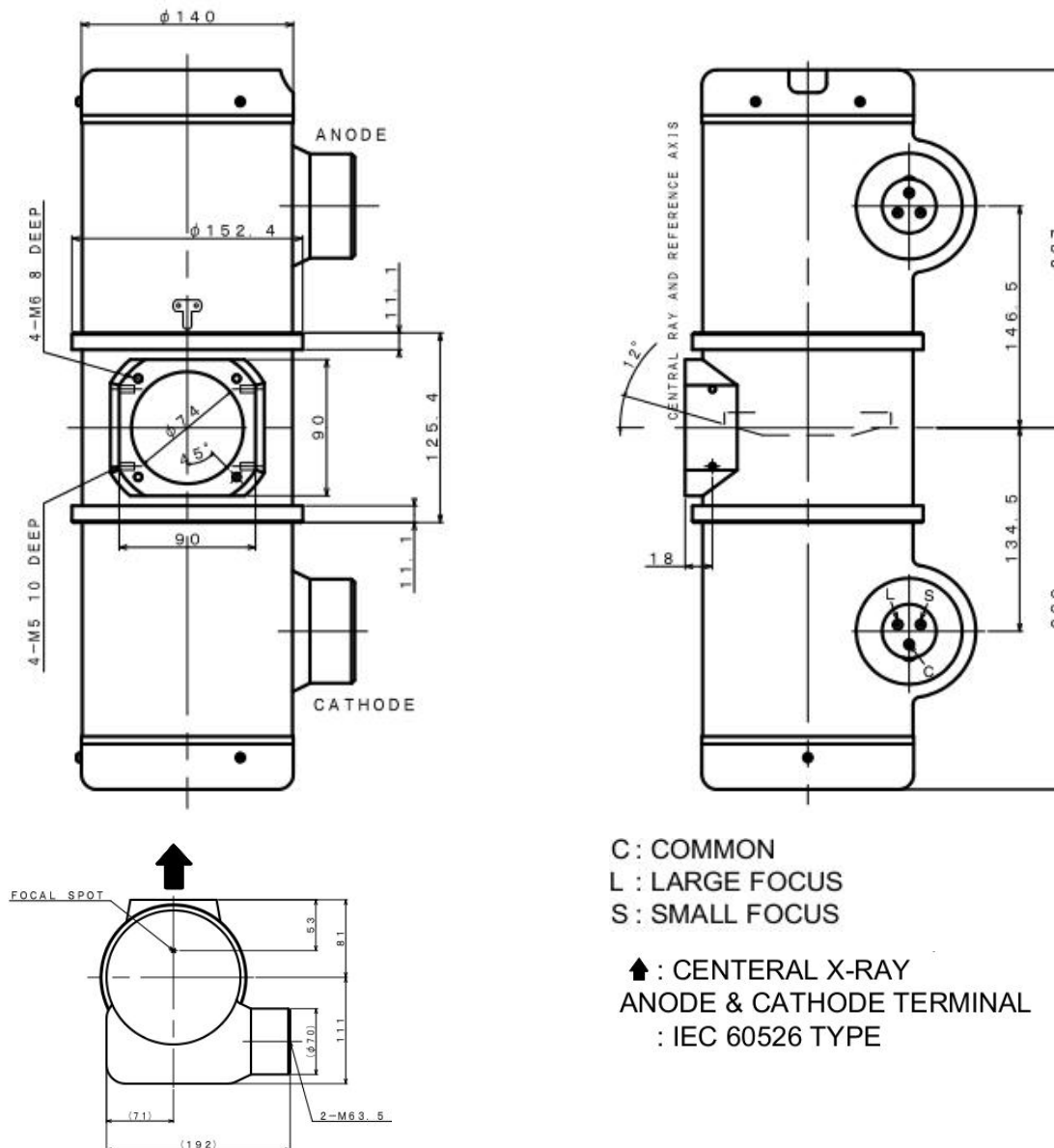


Figure 2-6 Outline drawings

## 2.3 Collimator

1. Radiation field:
  - Shape of radiation field: rectangle.
  - Minimum radiation field: when SID is 100 cm, the limit of the Collimator should be not more than 5 cm x 5 cm.
  - Maximum radiation field: when SID is 100 cm, limited to maximum radiation field of 43 cm x 43 cm.
2. Illumination of visible light: when SID is 100 cm,  $\geq 200$  lux

3. Lamp: LED lamp,24V, 5W
4. Light on limit time: maximum  $30 \pm 2$  s
5. Filtration:  
Inherent filtration:  $\geq 1\text{mmAl}$
6. X-ray field and light field is not coincidence degree, the  $< 2\%$
7. Overall dimensions:  $187\text{mm} \times 274.5\text{mm} \times 180.8\text{mm}$  (length  $\times$  width  $\times$  height)
8. Weight:  $6.5\text{kg} \pm 0.5\text{kg}$
9. Power: DC/AC12V~24V

## 2.4 Radiography table

1. Longitudinal travel of tabletop: 1300mm
2. Lateral travel of tabletop: 260mm
3. Height adjustable range of tabletop: 220mm
4. Electromagnetic lock detent force: not less than 100 N
5. Tabletop Load capacity : not less than 200 kg
6. Tabletop Equivalent filtration : not more than 1.2mmAl
7. Columns moving range: not less than 2500 mm
8. Rotation range of X-ray Assembly on the horizontal axis:  $\pm 90^\circ$
9. Rotation range of tube stand column:  $\pm 180^\circ$ , it should be positioned every other  $90^\circ$
10. Power supply condition:
  - a) Power supply : a.c.  $220\text{V} \pm 22\text{V}$ ,  $50\text{Hz} \pm 1\text{Hz}$ , 300VA;
  - b) Power resistance: no greater than  $4\ \Omega$

## 2.5 Vertical bucky stand

1. Vertical travel range of bucky along the column: not less than 1500mm
2. Bucky travel along the column vertically: rising pulling force is not more than 100N, descending pulling force is not more than 50N

## 2.6 Flat-panel detector

1.Detector Model :	PLD-1717CWE
2.Detector parameters :	
Effective Area :	430(H)×430(V)
Effective Array :	3072(H)×3072(V)
Pixel Size :	139μm
Cycle time :	Min.12s
X ray Energy:	40 ~ 150 kVp
Gray scales :	16 bit, 65536 grayscale
Spatial Resolution :	3.1 Lp/mm
Image Transfer :	Wireless:IEEE 802.11a/b/g/n (2.4 GHz / 5 GHz)
Image Acquisition Time (Wireless):	Preview Acquisition Time: 3 sec.
Both AP mode and Client mode:	Processed Acquisition Time: 7 sec. (including
Preview Time)	
Data Transmission Rate (Wireless):	802.11b: Max. 11Mbps
	802.11a/g: Max. 54Mbps
	802.11n: Max. 300Mbps (MIMO 2x2)
3、 Components and characteristics	
Image Sensor :	a-Si (Amorphous Silicon) TFT
Input :	DC 24V
Power consumption :	Max. 48W
Dimensions :	460 x 460 x 15 mm
Weight (Approx.) :	4.6kg
4、 Environmental conditions	
Temperature :	5 to 35 °C
Relative humidity :	30 to 75 % (Non-Condensing)

Atmospheric pressure : 700 to 1060 hPa

## 5、 Storage conditions

Temperature : -20 to 55 °C

Relative humidity : 10 to 90 % (Non-Condensing)

Atmospheric pressure : 700 to 1060 hPa

## 2.7 Loading Factor Combination

Focus	mA	kV	s	
Small Focus	10、 12.5、 16、 20、 25、 32	150	10	
		150	8	
	40	119	10	
		150	4	
	50	109	10	
		150	1.6	
	63	89	10	
		150	0.63	
	80	69	10	
		150	0.2	
	100	59	8	
		150	2	
	Large Focus	125	69	6.3
			150	1
160		79	5	
		150	0.63	
200		59	4	
		150	0.2	
250		59	3.2	
		150	0.4	
320		69	2.5	
		150	0.25	
400		69	2	
		131	0.16	
500		59	1.6	
		104	0.125	
630	49	1.25		

	800	81	0.16
		49	0.8

## 2.8 Earth leakage current

Normal condition:  $\leq 5\text{mA}$ , single failure state:  $\leq 10\text{mA}$ .

---

## CHAPTER3 PRE-INSTALLATION

### 3.1 The room requirements and Layouts

The room requirements of radiographic system:

1. X-ray room area: no less than 4000×5000mm.
2. Control room area: 2500 × 5000mm; the control room shall be opening on to the machine room, and the observation window shall be equipped with lead glass.
3. X-ray room height: at least 2800mm.
4. X-ray room door: Width: 1500mm; height: 2300mm.
5. The radiographic table shall be directly fixed on ground base which shall be horizontal and can bear 1500kg of load.



***The foundation shall adopt cement with grade no less than 400" and casting thickness no less than 200mm.***

6. Cable duct shall be set with cover plate parallel to the ground.
7. The X-ray room shall be equipped with special ground wire with ground resistance not exceeding 4Ω.
8. X-ray Protection capability of the machine room shall meet requirements of related national regulations.

The layout of machine room is as shown in Figure3-1

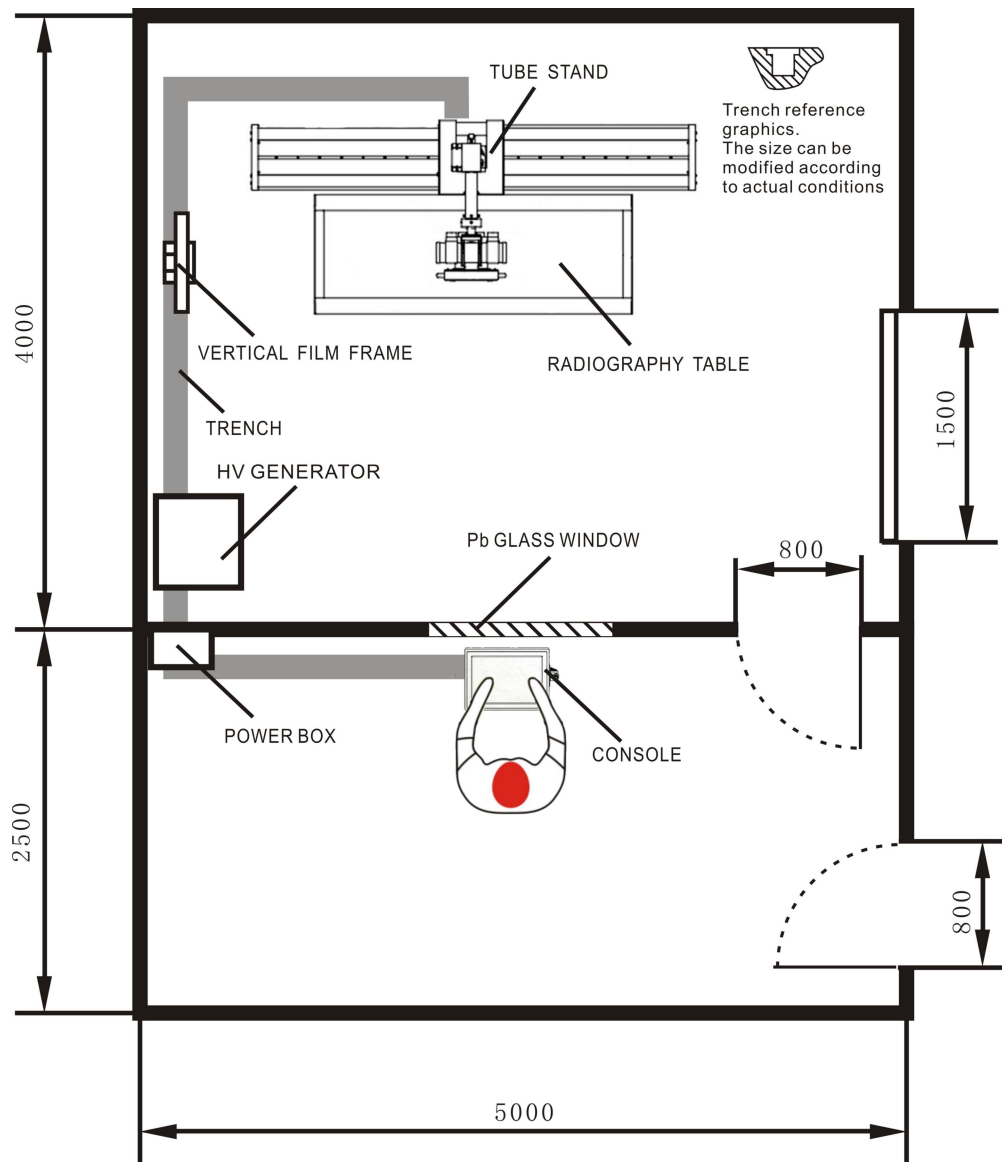


Figure 3-1 Layout of X-ray room

## 3.2 Electrical requirements

### 1. Power conditions:

- Three-phase four-wire a.c.  $380\text{V} \pm 38\text{V}$ ,  $50\text{Hz} \pm 1\text{Hz}$ ;
- Internal resistance of power source shall not exceed  $0.17\Omega$ ;
- Power capacity shall be no less than  $105\text{kVA}$ .

2. The power distribution box shall be equipped with three-phase main switch with rated voltage of  $500\text{V}$  and rated current of  $160\text{A}$  as the switch to break power supply network; the power distribution box must be firmly fixed on the wall with no less than  $1.5\text{m}$  of height from the indoor floor. Besides, power supply with capacity no less than  $105\text{kV}$  and independent ground wire (no more than  $4\ \Omega$ ) shall be provided.

### **3.3 Environmental conditions**

#### **OPERATING**

- Ambient temperature: 10°C ~ 40°C
- relative humidity: 30% ~ 75%
- atmospheric pressure: 70kPa ~ 106kPa

#### **TRANSPORT AND STORAGE**

- Ambient temperature range: -20 to 70 °C.
- Relative humidity: 10 to 95%, including condensation.
- Atmospheric pressure range: 500 to 1060 kPa (375 to 795 mm Hg).



## CHAPTER4 INSTALLATION OF THE EQUIPMENT

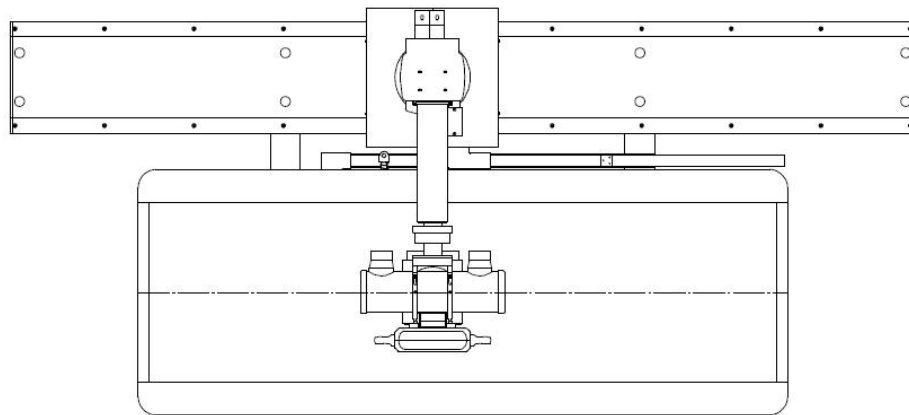
### 4.1 Overview

The equipment must be installed and adjusted by professional personnel of our Company or authorized by our Company.

Before opening the packing case, it shall be stored in the rain-proof and dust-free environment; and boxboard shall be opened reasonably while opening the case. While handling the parts, attention shall be paid to avoid scratching parts surface; check according to the packing list after opening the case and installation shall only be conducted after confirming the machine is defect and omission; any problem shall be informed to the Company for us to dispose in time.

### 4.2 Radiography table installation

#### 4.2.1 Position of the rail and the table base

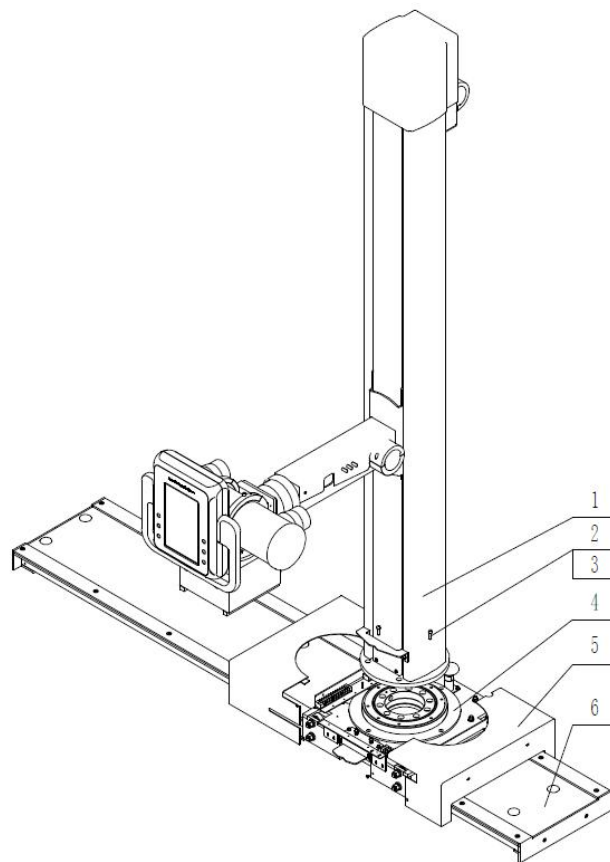


*Figure 4-1 base installation schematic diagram*

- 1、 According to the figure 4-1, to put the radiography table and the ground rail on the right position of the X-ray room.
- 2、 Determine the optimal installation position of the machine , if level calibration has been done, to fix photographic table and ground rail with M10 x 100 and M8 x 100 expansion anchor bolt.

## 4.2.2 Installation of the tube stand

- 1、 Remove the cover which is installed on the column stand holder of the guide way.
- 2、 Take the column stand out of the packing case carefully, make sure it stand vertically and install it on the column stand holder, and fix the column stand with four hexagon socket screws M8×25.
- 3、 Tighten the cover with semicircular cross groove screws, check and make sure whether the column stand move smoothly. As shown in figure 4-2.



1-The column stand    2/3-hexagon socket screw M8×25    4-the column stand holder  
5-cover    6-The guide way of the column stand

Figure 4-2 Installation diagram of the column stand

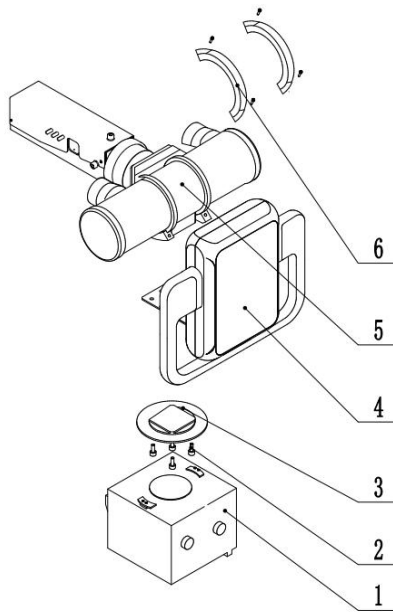
## 4.2.3 The installation of X-ray source assembly

- 1) Install the X-ray tube assembly on the tube support with six hexagon socket screws M5×20, according to the installation diagram of the tube, control box and collimator.
- 2) Loosen four hexagon socket screws M6×25 on the X-ray tube fixed clamp, install the

X-ray tube, then install the X-ray tube fixed clamp on the tube with hexagon socket screw M6×25.

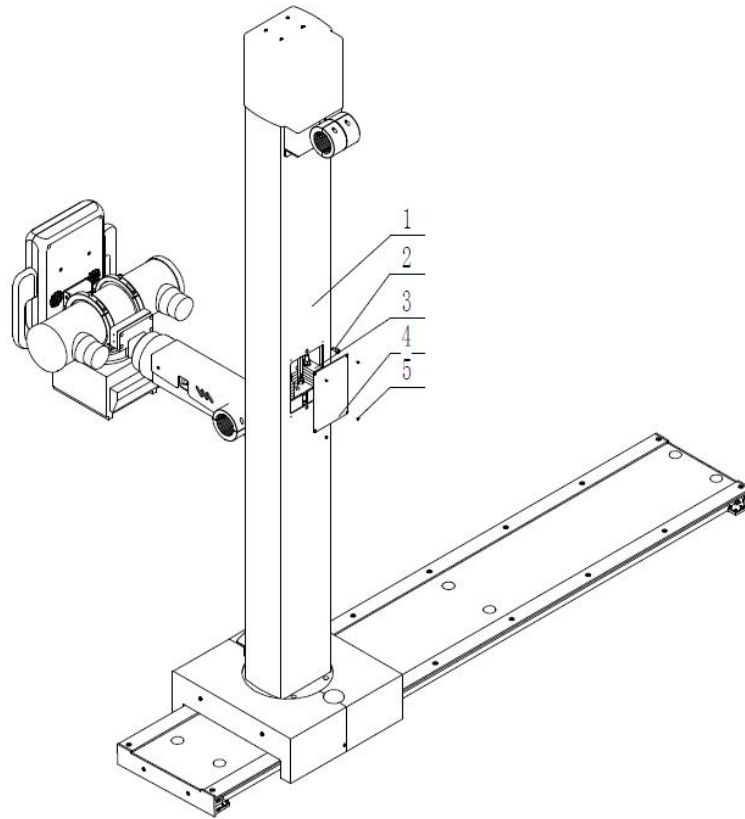
3) By using four hexagon socket screws M10×25, washer M6, the screws can in turn pass through the mounting plate of collimator, fixing plate of control box and the collimator spacer, and tight the screws to fix on the X-ray tube.

4) Loosen four hexagon socket screws which are attached on the collimator, put the collimator fastening cone on the mounting plate of collimator, tight the screws after adjust collimator position, and the collimator is fixed on the mounting plate of collimator, as shown in figure 4-3.



1-Manual collimator    2-Hexagon socket screw M6X25, washer M6    3-Mounting plate of collimator  
4-Control box    5-X-ray tube    6-Mounting component of tube

#### 4.2.4 Installation of counter weight

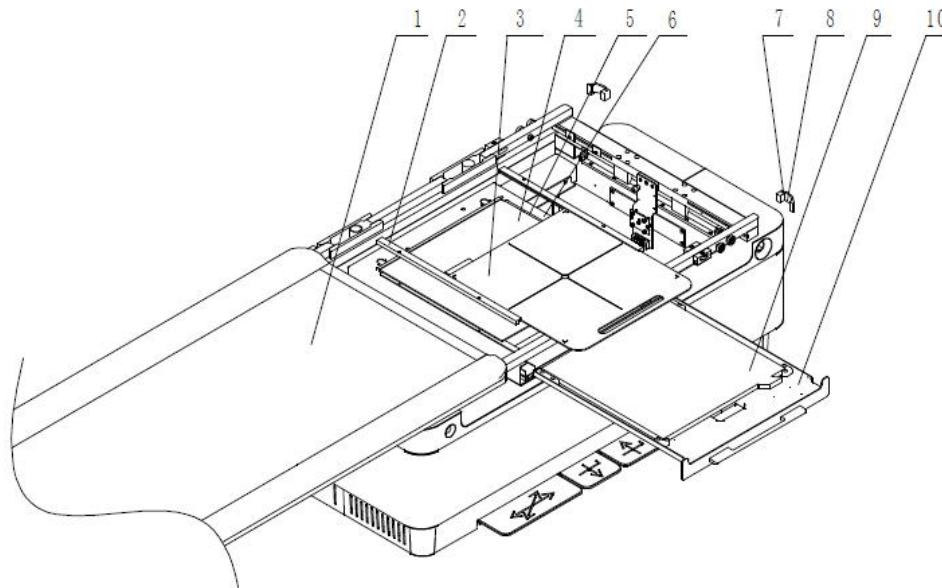


1-Column stand 2-Additional counterweight 3-Main with heavy 4-Heavy cover plate 5-screw

Figure 4-4 Installation diagram of counter weight

1. Remove the counterweight cover plate;
2. Add additional counterweight blocks according to the weight of the ball tube-limiter assembly (if the ball tube-limiter assembly is moving up and down along the lifting tube, it can be stopped at any position after unlocking);
3. Tighten the removed counterweight cover plate again with screws again.

## 4.2.5 Installation of the detector and AEC ionization chamber (optional)



1. Bed panel assembly    2. ionization chamber pressure plate    3. filter gate    4. ionization chamber  
 5. ionization chamber support plate    6. Box frame    7. Bed surface end cover    8. screw    9. detector  
 10. detector tray

*Figure 4-5 Installation diagram of the detector and grid*

1. Remove the limit block and the bed surface end cover assembly at one end of the bed panel, and pull out the bed panel;
2. Pull out the detector tray and place the detector on the tray tray;
3. Put the ionization chamber support plate, ionization chamber and ionization chamber pressure plate on the sheet box frame in turn, use screw compression, and insert the filter grid into the ionization chamber pressure plate;
4. Install the bed panel, and fix the limit block and the bed surface end cover assembly with screws again.

## 4.3 Installation of Vertical Bucky Stand

### 4.3.1. Positioning of the base

The base positioning of the vertical bucky stand is shown in the figure 4-6.

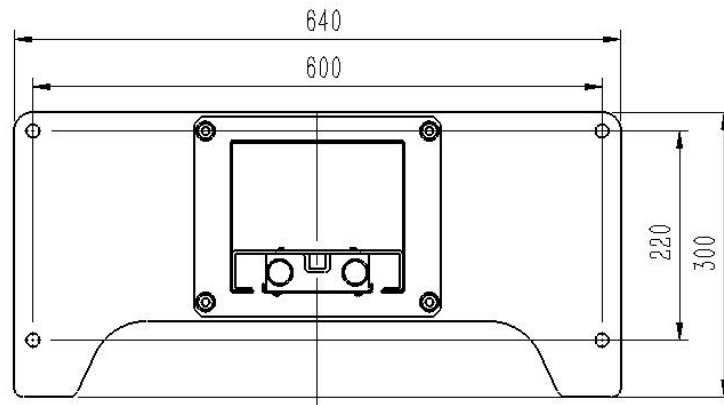
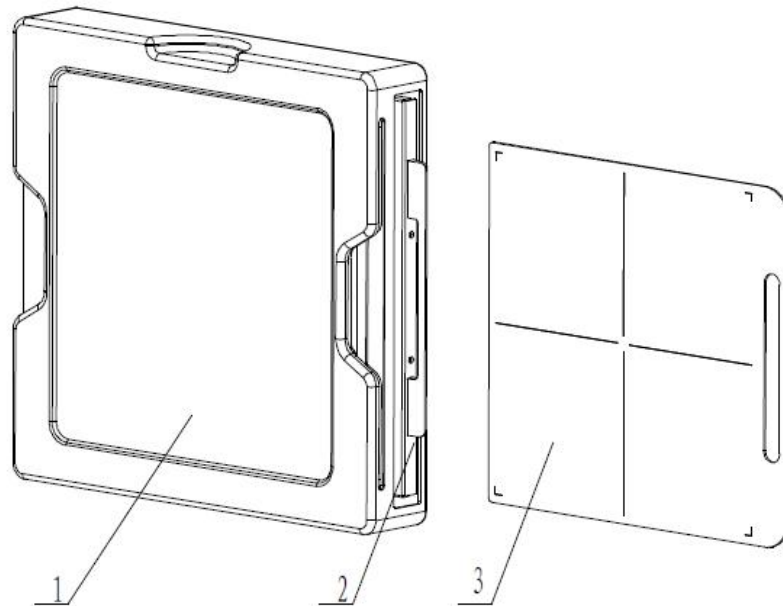


Figure 4-6 The installation diagram of the base

Select the installation position of the vertical bucky stand according to the radiography table which is installed on the floor, and drill four expansion nut holes M10(the diameter of the holes are less than 12mm ),then fix the vertical bucky stand to the floor by tight the hexagon socket screws M10×25 (fitted with flat washer and spring washer).

### 4.3.2 Installation of detector and filter grid



1. Box assembly 2. Detector tray 3. Portable portable filter grille

Fig. 4-6 Installation diagram of detector and filter grid

1. Pull the detector tray out of the chip box assembly, load the detector into the tray, and then push the tray back into the chip box assembly again.
2. The chest chip frame is used with a portable mobile filter grille. When used, according to

the SID distance, the corresponding focal length filter grille can be selected to insert into the filter grille slot.

## 4.4 Cable connections



**Some safety devices such as Safety Switch / Emergency Switch, Warning Light, and Door Interlock Switch are supplied and installed by the customer. Verify that safety devices have been properly installed and routed during the Pre-Installation procedure.**

### 4.4.1 Power cables and protective ground wire connection

#### 1、 Main power cable D:

High voltage generator	Main power cable D	Main Power Supply
X1 terminal	(XJZ10.04)	terminal
U	L1	plug
V	L2	
W	L3	
N	N	

#### 2、 Radiographic Table Power Cable:

Radiography table	Radiographic Table Power Cable	High voltage generator
X1 terminal	(XJZ20.11)	X2 terminal
X1-1	L	W
X1-2	N	N

#### 3、 Console Panel Power Cable:

Generator Console	Console Panel Power Cable	Radiography table
PCB60.32	(XJZ20.10)	X1 Terminal
J1-1	2125	X1-3
J1-2	2124	X1-4

#### 4、 Collimator Power Cable E:

Collimator	Collimator Power Cable E	Radiography table
plug	(XJZ10.63)	PCB20.43
3P Aviation Socket	— —	J8

#### 5、 AC220V Power Cable B:

Control Box	AC220V Power Cable B	Radiography table

Plug	(XJZ30.57)	X1 Terminal
AC IN	2125	X1-5
	2124	X1-6

#### 4.4.2 High voltage generator cables connection

##### 1、Control Box Cable:

High voltage generator	Control Box Cable	Mini Control Box
X3 Terminal	(XIZ10.81)	Plug
X3-4	TB-4	PM1
X3-5	TB-5	
X3-6	TB-6	
X3-7	TB-7	
X3-8	TB-8	
X3-9	TB-9	
X3-10	TB-10	
X3-11	TB-11	
X3-31	TB-31	



##### 2、CAN BUS Communication Cable:

High voltage generator	CAN BUS Communication Cable	CAN-USB Convertor
Plug (Interface Board)	(XIZ10.80)	Plug
PC8	_____	CAN1

##### 3、USB Cable:

Computer	USB Cable	CAN-USB Convertor
Plug		Plug
USB	_____	USB

##### 4、Stator Cable E:

High voltage generator	Stator Cable E	X-ray tube Assy.
X3 Terminal	(XJZ10.54)	Terminal
15	1	1
16	3	3
17	2	2
18	4	5
19	5	6
	FG	

##### 5、High Voltage Cable:

High voltage generator	High Voltage Cable	X-ray tube Assy.
Plug		Plug



-CATHODE- +ANODE+	High voltage cathode High voltage anode	-CATHODE- +ANODE+
----------------------	--	----------------------

## 6、Generator Emergency Stop Cable A:

High voltage generator	Generator Emergency Stop Cable A (XJZ10.70)	Radiography table
PP8B		X1 Terminal
PP8B-2	2595	X1-11
PP8B-3	2596	X1-12

## 7、Generator Exposure Control Cable C:

High voltage generator	Generator Exposure Control Cable C (XJZ30.61)	High voltage generator
X3 Terminal		J2 Terminal
X3-1	3605	J2-4
X3-2	3603	J2-2
X3-3	3602/3604	J2-1/3

## 8、Detector Power Cable:

Detector	Detector Power Cable (XJZ30.83)	Control Box
Plug		plug
J1	_____	PORT

## 9、Detector Exposure Control Cable :

Control Box	Detector Exposure Control Cable (XJZ30.82)	High voltage generator
Plug		J1 Terminal
SYNC	3660	J1-1
	3661	J1-2
	3662	J1-3

## 4.4.3 Console Panel cable connection

## 1、Speaker Cable :

Intercom System	Speaker Cable (XJZ40.23)	Speaker
J4(PCB40.02)		Plug
J4	_____	Plug

## 2、Gigabit Ethernet Cable E:

Control Box	Gigabit Ethernet Cable E (XJZ30.84)	Computer
Plug		Plug
LAN	_____	RJ45

## **4.5 Final Check**

The base of Radiographic table has positioning and installation correctly, the bucky wall stand has positioning and installation correctly, all of screws and assembly fixed without looseness, confirms all of cables has been connected correctly.

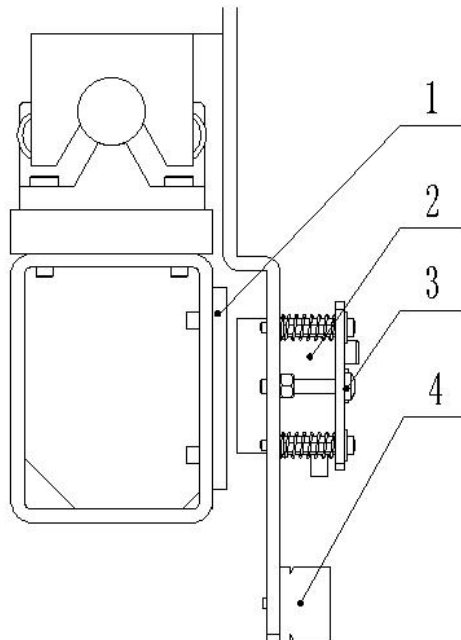
## CHAPTER5 CALIBRATION OF THE EQUIPMENT

### 5.1 Calibration of radiography table

#### 5.1.1 Electromagnet adjustment

##### 1、Adjustment of tabletop movement transversal brake electromagnet

Transversal brake electromagnet of the tabletop installed on transversal pulley frame which is installed on the transversal sliding frame assembly, its installation method as shown in the figure 5-1.



1 - brake body 2 - longitudinal brake electromagnet 3 - adjusting screw (2) 4 - terminal strip

Figure 5-1 Transversal brake electromagnet of the tabletop movement

Firstly, the transversal brake electromagnet of the tabletop movement is powered up and make it loosen the suction, adjust the bolt as shown in the figure 5-1, make the size of gap between the transversal brake electromagnet and the brake pad is 1mm.

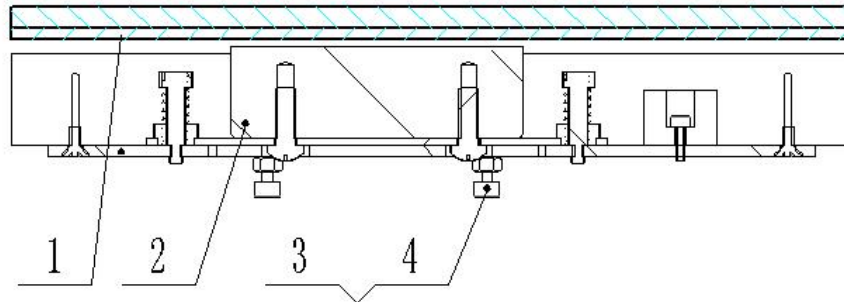
Secondly, the transversal brake electromagnet of the tabletop movement is powered off, and test the effects of the electromagnet brake and release, normally, the transversal brake electromagnet can suck the brake pad when it is powered off, the transversal brake electromagnet can release from the brake pad automatically when it is powered up.

Finally, tighten the fixing nut, make sure the size of gap between the transversal brake

electromagnet and the brake pad is not change during operating mode.

## 2、Adjustment of tabletop movement longitudinal brake electromagnet

The longitudinal brake electromagnet of the tabletop movement installed on the idler wheel frame of left and right sides which are installed on the base of radiography table, the installation method as shown in the figure 5-2.



1 - brake body 2 - Transverse brake electromagnet 3、4 - adjusting screw

Figure 5-2 Longitudinal brake electromagnet of the tabletop movement

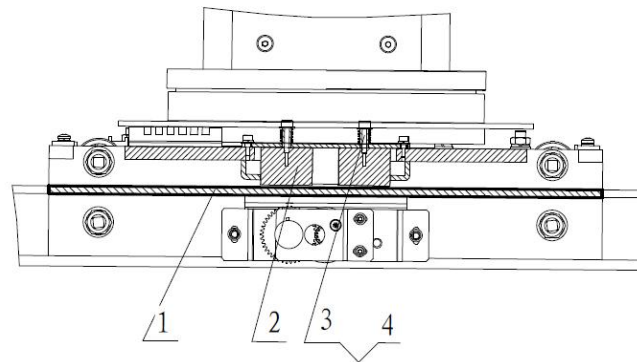
Firstly, the longitudinal brake electromagnet of the tabletop movement is powered up and make it loosen the suction, adjust the bolts as shown in the figure 5-2, make the size of gap between the longitudinal brake electromagnet and the brake pad is 1mm.

Secondly, the longitudinal brake electromagnet of the tabletop movement is powered off, and test the effects of the electromagnet brake and release, normally, the longitudinal brake electromagnet can suck the brake pad when it is powered off, the longitudinal brake electromagnet can release from the brake pad automatically under the spring force when the electromagnet is powered up, the size of spring force can be adjusted by adjusting the bolts which are on the shell of the longitudinal brake electromagnet.

Finally, tighten the fixing nut, make sure the size of gap between the longitudinal brake electromagnet and the brake pad is not change during operating mode.

## 3、Adjustment of column brake electromagnet

The movement brake electromagnet of the column is installed on the movement mechanism of the column, the brake pad is installed on the guide way of the column, the installation method as shown in the figure 5-3.



1-The guide way of the column    2-Brake pad    3- Brake electromagnet    4-Adjusting bolt

Figure 5-3 Column movement brake electromagnet

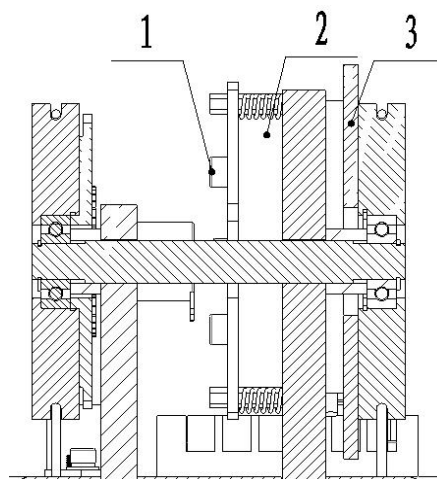
Firstly, the movement brake electromagnet of the column is powered up and make it loosen the suction, adjust the bolts as shown in the figure 5-3, make the size of gap between the brake electromagnet and the brake pad is 1mm.

Secondly, the brake electromagnet is powered off, and test the effects of the electromagnet brake and release, normally, the brake electromagnet can suck the brake pad when it is powered off, the brake electromagnet can release from the brake pad automatically under the spring force when the electromagnet is powered up, the size of spring force can be adjusted by adjusting the bolts which are on the shell of the brake electromagnet.

Finally, tighten the fixing nut, make sure the size of gap between the brake electromagnet and the brake pad is not change during operating mode.

#### 4、 X-ray tube elevator brake electromagnet adjustment:

The tube elevator brake electromagnet installed at the pulley of the roller shaft on the top of column, its installation method as shown in the figure below.



1- adjusting screw    2 - electromagnet    3 - brake body

*Figure 5-4 Tube elevator brake magnets*

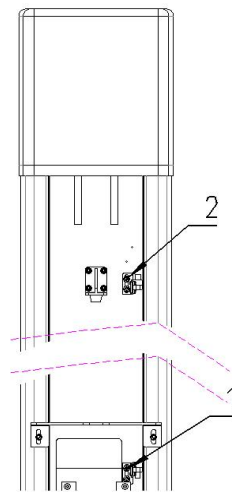
First of all, power the electromagnet to make it unlocked, adjustment the screw(1) shown in the figure 5-4, the clearance between the brake electromagnet (2) and brake body(3) must be 1 mm.

And then, without power, test the effect of electromagnet brake and release, normal power can suck, Have power rely on spring self-esteem don't suck. the elastic can be adjusted the size of the brake electromagnet shell the spring on the adjusting bolt.

Finally, tighten solid nut (1), to ensure that the clearance between brake body (3) and the brake electromagnet (2) will not change in the work.

### 5.1.2 Commissioning of ball pipe lifting

1. Motor direction debugging The tube lift is driven by a DC motor, press the key on the head assembly panel, press the key on the head assembly panel, and drop down; in the opposite direction, switch the two motor wires on the top terminal row of the column.
2. Commissioning of ball pipe lifting limit



*1-Ball tube drop limit optical coupling    2-Ball tube rise limit optical coupling*

*Figure 5-5 X-ray tube rotating brake electromagnet*

To block the ball tube drop limit photocoupling, the LED9 signal light on the PCB60.34 circuit board is off and the light is off. To block the ball tube rising limit photocoupling, the LED10 signal light on the PCB60.34 circuit board is off and the light is off. If the corresponding signal light is not normal, check the corresponding line and the corresponding limit optical coupling.

### 5.1.3 Commissioning of bed surface lifting

#### 1. Motor direction debugging

The bed surface lifting is driven by DC electric push rod to press on the rising control pedal of the bed surface. In the opposite direction, then the two motor lines on the inner terminal row of the bed base shall be replaced.

#### 2. Bed face lifting and lifting limit debugging

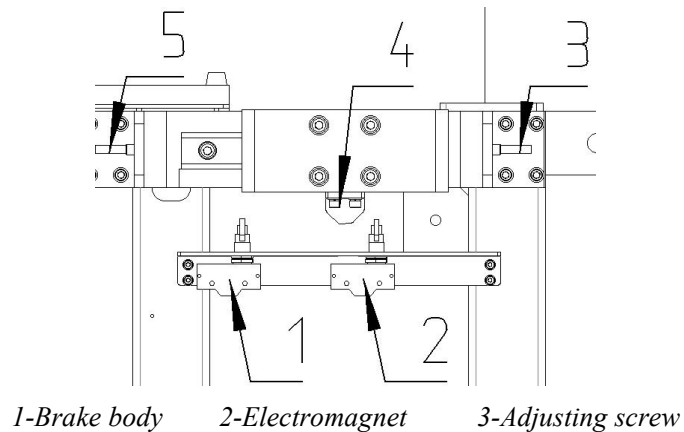



Figure5-6 Film electromagnet

Press the bed drop limit switch, J15-1 and J15-2 on the PCB60.34 circuit board shall be disconnected and loosened. Press the upper limit switch off the bed surface and connect between J15-5 and J15-6 on the PCB60.34 circuit board. If the corresponding signal is abnormal, check the corresponding line and the corresponding limit switch.

## 5.2 Data Calibration

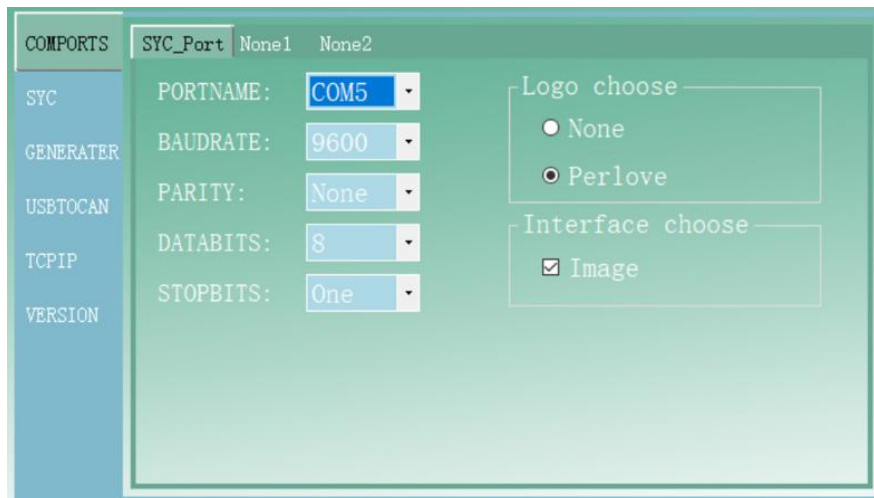
#### 1. Entering Into the Calibration Mode

- 1) Power on the device. Click the  icon in the lower left corner of the interface. The password interface is displayed .



- 2) Enter the password 1845 and press OK button to enter the debugging mode.

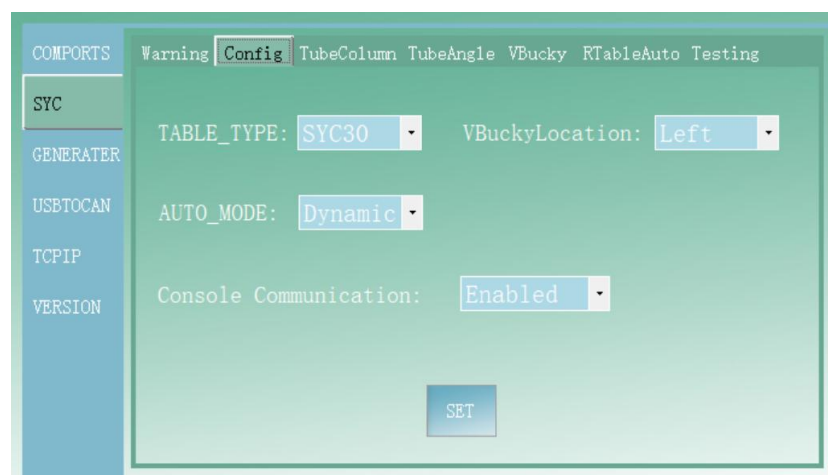
## 2.Setting Serial Port Parameters



- 1) PORTNAME: Select the serial port number
- 2) BAUDRATE: 9600
- 3) PARITY: None
- 4) DATABITS: 8
- 5) STOPBITS: one

## 3.Table Setting

Click the "SYC" menu in the debugging interface and select the "Config" option, as shown below:



- 1) TABLE\_TYPE: table type, choose the appropriate table size.
- 2) V Bucky Location: Position of vertical bucky stand, select the corresponding direction



according to the actual position of vertical bucky stand.

3) AUTO\_MODE: Automatic mode, select Dynamic.

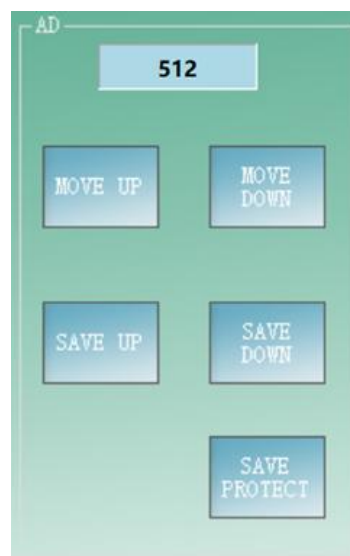
4) Console Communication: If there are control boxes, select Enable; otherwise, select Disable .



#### 4. Tube Lifting Debugging

Click the "SYC" menu in the debugging interface and select the "TubeColumn" option, as shown below:



#### 1) Tube Lifting Potentiometer Debugging

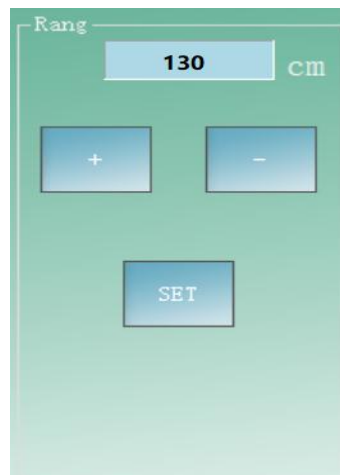


A. Press the rise button  on the tube or down button , can move the tube rise and down, When the tube down, the AD value should be reduced; The AD value should increase as the tube rises .



B. Lower the tube to the lowest, press  save the minimum value of the tube lift.


C. Raise the tube to the highest, press  save the maximum value of the tube lift.

## 2) Tube Lifting Stroke Debugging

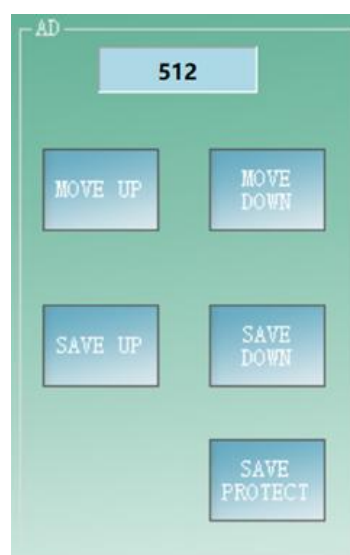



A. Lift the tube from the lowest to the highest, measure the actual lifting stroke of the tube (unit: CM);


B. Press  or  select the value as the actual measured value and press


 save the value.

## 3) Safety Height Adjustment of Tube Lifting

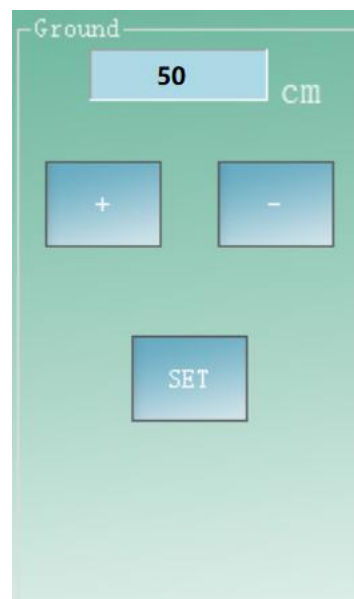


A. Rotate the tube to the horizontal position, press the tube up button  or down




button , so that the distance between the focus of the tube and the image receiving surface is  $50 \pm 1$  CM

B. Press the  button, save the AD value of the safe lifting height of the tube.

#### 4) Minimum Distance Between the Focus of the Tube and the radiography table

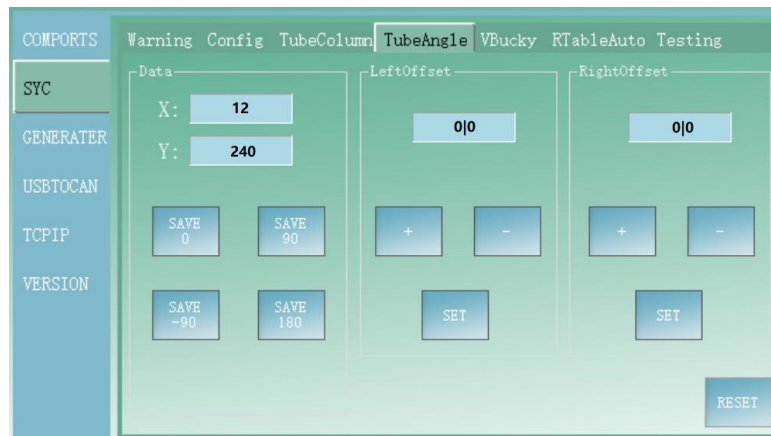


A. Rotate the tube to a horizontal position, adjust the distance between the focus of the tube and the image receiving surface to  $50 \pm 1$  CM, and measure the actual distance between the focus of the tube and the image receiving surface of the radiography table (unit: CM)






B. Press  or  select the value as the actual measured value and press  save the value.

#### 5. Tube Rotation Debugging

Click the "SYC" menu in the debugging interface and select the "TubeAngle" option, as shown below:






### 1) Save the Rotation Angle Value

- A. Press  button, Data initialization, and then power - off restart
- B. Rotate the tube to  $0^{\circ}$  and press  save the numerical.
- C. Rotate the tube to  $+90^{\circ}$ , and press  save the numerical.
- D. Rotate the tube to  $-90^{\circ}$ , and press  save the numerical.
- E. Rotate the tube to  $+180^{\circ}$ , and press  save the numerical.

### 2) Rotation Angle Display Value Correction

If there is a deviation between the displayed value of the tube rotation Angle and the measured value after saving the rotation Angle value, the following methods can be used for correction:

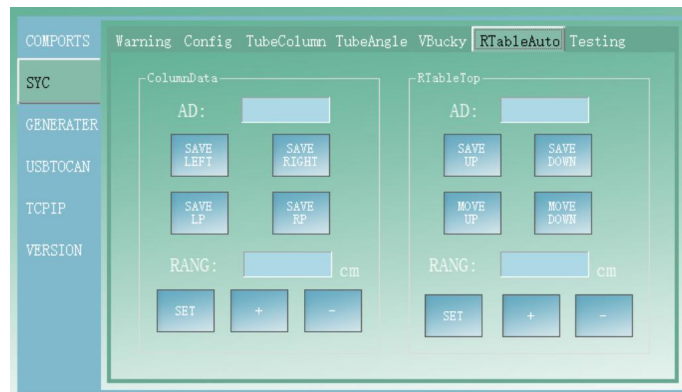
- A. The ratio of the Angle display value to the correction value is  $1^{\circ} : 10$
- B. The correction value is positive, indicating that the display value should be increased; Is negative, indicating that the display value is reduced
- C. "LeftOffset" is LeftOffset at corrective levels from  $0^{\circ}$  to  $+90^{\circ}$ ;
- D. "RightOffset" is RightOffset at corrective levels from  $0^{\circ}$  to  $-90^{\circ}$

- E. Click under the corresponding option  or  select the value as the required correction value and press  to save the value.

### 6. Vertical Movement Debugging of Column


In the debugging interface, click "SYC" menu and select "RTableAuto" option. The "ColumnData" option box is the column longitudinal movement debugging data, as shown


below:



### 1) Column Longitudinal Mobile Potentiometer Debugging




A. Press the unlock button to move the column vertically. When the column moves to the left, the AD value should increase; When the column moves to the right, the AD value should be reduced.

B. When moving the column to the far left, press  button, save the maximum vertical movement of the column

C. When moving the column to the far right, press  button, save the minimum vertical movement of the column.

### 2) Adjustment of Vertical Moving Stroke of Column


A. Move the column from the left to the right, and measure the actual vertical stroke of the column (in CM);

B. Press  or  select the value as the actual measured value and press  save the value .

### 3) Adjust the Safety Distance of Column Longitudinal Movement


A. Move the tabletop to the right longitudinal pressure to the left side of the tabletop mobile protection switch;

B. Move the column to the left, rotate the tube to the horizontal position, press the tube up button or down button, so that the tube and the tabletop in the same level, move the column, so that the minimum distance between the end of the tube and the tabletop is  $4 \pm 1$ CM;

C. Press , save the AD value of the safe distance to the left of the vertical movement of the column

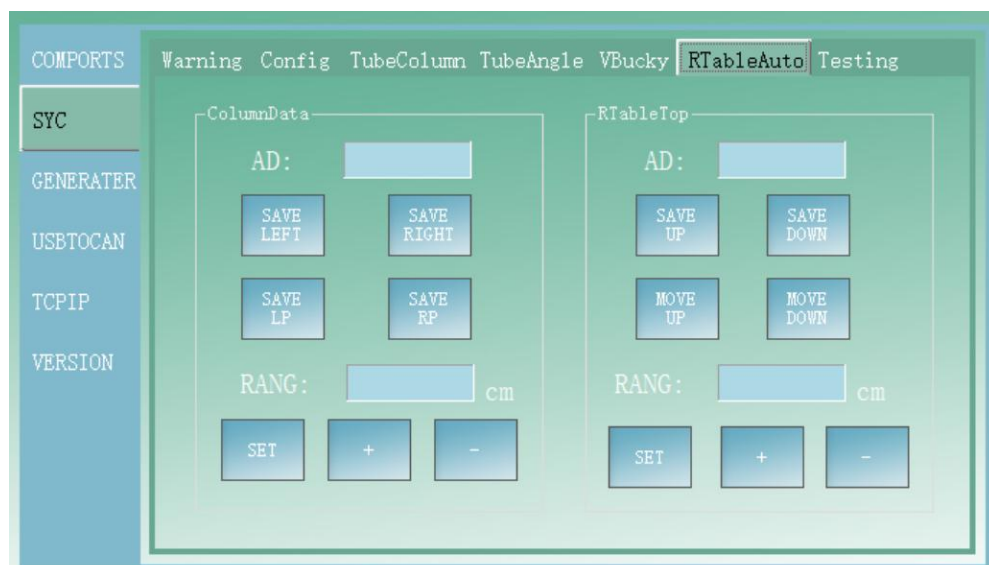
D. Move the tabletop to the left longitudinal pressure to the right side of the tabletop mobile protection switch;

E. Move the column to the right, rotate the tube to the horizontal position, press the tube up button or down button, make the tube and the tabletop at the same level, move the column, make the minimum distance between the end of the tube and the tabletop is  $4 \pm 1 \text{CM}$ .



F. Press , save the AD value of the safe distance to the right of vertical movement of the column.

## 7. Tabletop Lifting Debugging

Click "SYC" menu in the debugging interface and choose "RTableAuto" option. The "RTableTop" option box is the tabletop lifting debugging data, as shown below:




### 1) Table Elevation Potentiometer Debugging

A. Press the up button  or down button  to lift the table. When the tabletop drops, the AD value should be reduced; When the tabletop rises, AD value should increase.




B. Lower the tabletop to the lowest, press , save the minimum elevation of the

tabletop.

C. Raise the tabletop to the highest, press , save the maximum elevation of the tabletop.

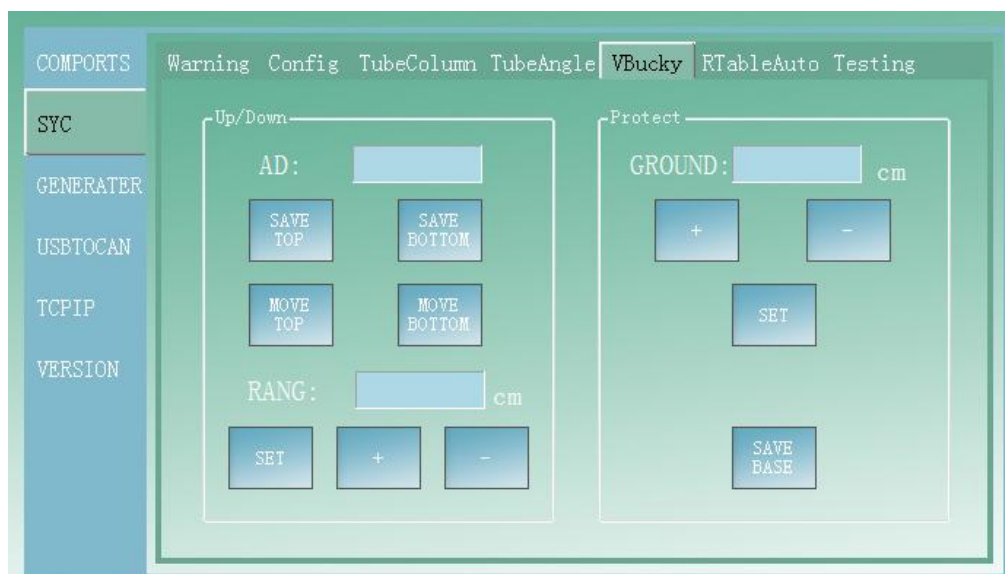
## 2) Tabletop Lifting Stroke Debugging

A. Lift the bed from the lowest to the highest, and measure the actual lifting stroke of the table (in CM) .



B. Press  or  select the value as the actual measured value and press  save the value.

## 8. Associated Debugging Between Radiography Table and Vertical Bucky Stand


Before debugging in this step, please complete the debugging of the motor and limit of the chest film frame according to "5.2 Chest Film frame Debugging". In the debugging interface, click the "SYC" menu and select the "VBucky" option, as shown in the picture below




## 1) Vertical Bucky Stand Lifting Potentiometer

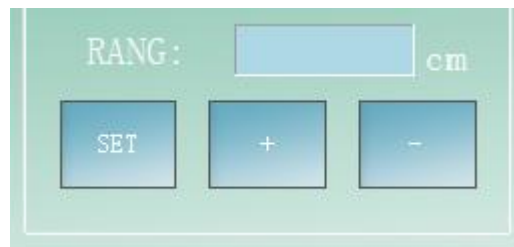
A. Press the up  or down  button to move the vertical bucky stand up and down. The AD value should be reduced when the vertical bucky stand is lowered. The AD value should be increased when the vertical bucky stand is

raised.




B. Lower the vertical bucky stand to the lowest, press , save the minimum value of vertical bucky stand lift.

C. Raise the vertical bucky stand to the highest, and press  save the vertical bucky stand lifting maximum value.

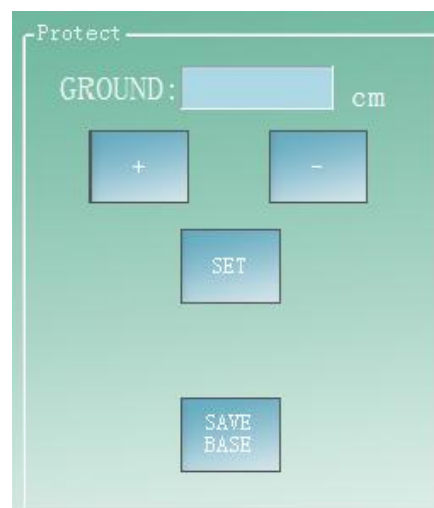
## 2) Adjustment of Vertical Bucky Stand Stroke



A. Lift the vertical bucky stand from the lowest to the highest, and measure the actual lifting stroke of the vertical bucky stand (unit: CM);

B. Press  or  select the value as the actual measured value and press  save the value.




## 3) Minimum Distance Between Vertical Vucky Stand and Focal Point of Tube



A. Turn the tube to a vertical position in the direction of the vertical bucky stand, move the column to the minimum distance from the vertical bucky stand, and measure the actual distance from the focus of the tube to the image receiving surface of the





vertical bucky stand (unit: CM) ;

B. Press  or , select the value as the actual measured value and press  save the value .

#### 4) Automatic Tracking and Debugging of the Tube and Vertical Bucky Stand



A. Turn the tube to the direction of the vertical bucky stand to the vertical position, move the column to the minimum distance from the vertical bucky stand, and reduce the tube to the lowest position;

B. Turn on the field light of the beam limiter and lift the vertical bucky stand to make the center line of the vertical bucky stand coincide with the cross center line of the field of the collimator.

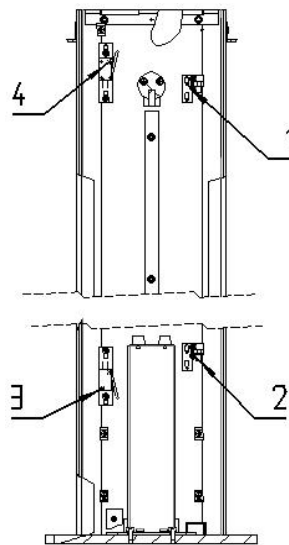
C. Press  on the "TubeColum" option screen and press  on the "VBucky" option screen respectively to ensure that the tube and vertical bucky stand automatically track and align.

### 5.3 Commissioning of the chest film frame

#### 1. Motor direction debugging

The cartridge assembly is driven by a DC motor, press the  key on the handle of the chest plate bar, press the  key on the handle of the chest plate bar; if in the opposite direction, change the two motor wires on the top terminal row of the column.

#### 2. Commissioning of the lifting and lifting limit of chip box components



*Up-limit photocoupling    2. Drop-limit optical coupling  
3. Lower the limit switch    4. Raise the limit switch*

*Figure 5-7 Lift and limit of the box assembly*

If the drop limit photocoupling, the LED8 signal light on the PCB60.34 circuit board is off and the light is off. To block the rising limit photocoupling, the LED7 signal light on the PCB60.34 circuit board is off and the light is off. If the corresponding signal light is not normal, check the corresponding line and the corresponding limit optical coupling.

## 5.4 Software Installation of image Acquisition Workstation

### 5.4.1 DR Software Installation

For the official version, user needs to start the installation from the CD-ROM, if it isn't automatically start, double click "XX\_DR\_Setup.exe"; for the demo version, mostly the user will get an installation package, and then just double click "XX\_DRConsole\_DEMO.exe".

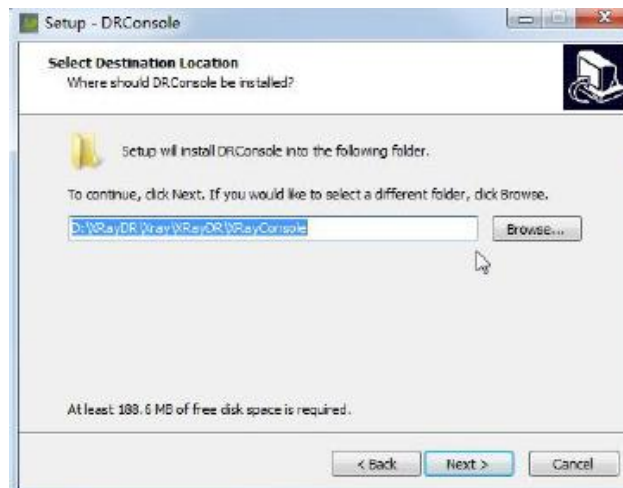
Double click to start the installation, the following steps will display:



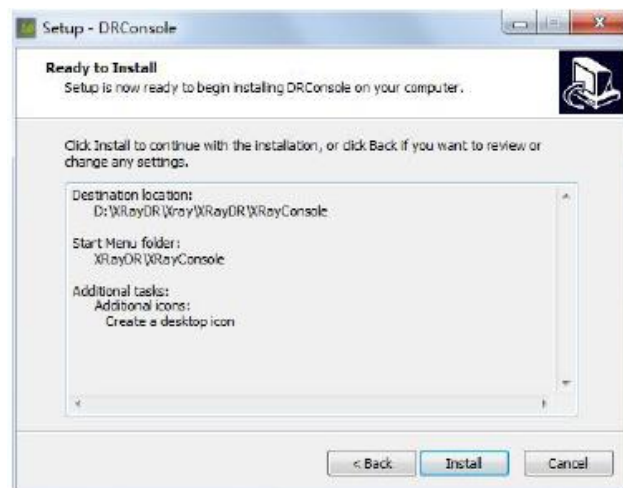
Finish preparing:



Select folder:



Confirm installation:



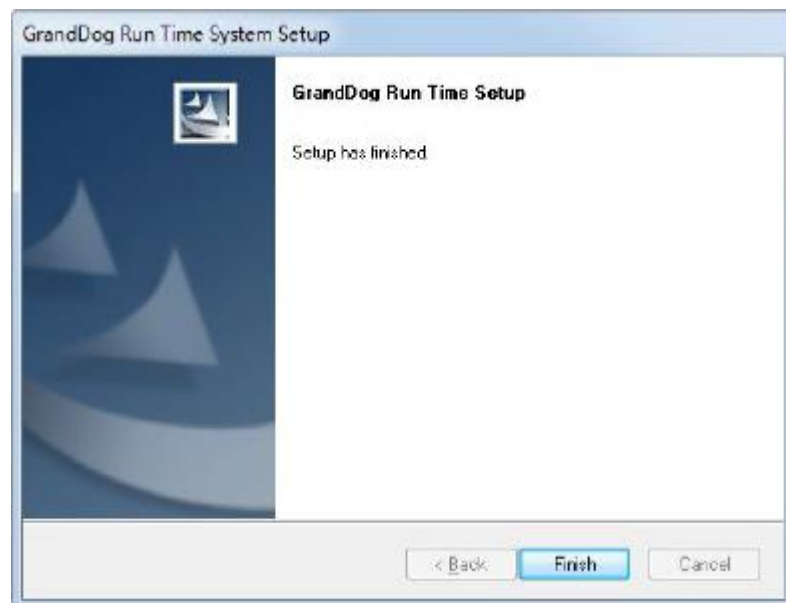
Finish installation



Install the granddog driver. (For official version only):



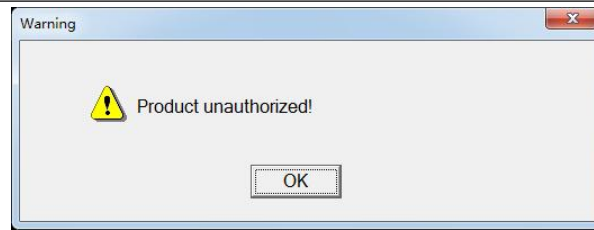
Finish installation



Wait for the end of necessarily file operation.

After the installation steps above, the program will create shortcut of “DRConsole.exe” and “DRDongle.exe”. User can double click the “DRConsole.exe” to start the program, or double click the “DRDongle.exe” to register the software.

**[Warning]** if the official version is unregistered, the program will show message in Figure” Unauthorized messages”, then the program will automatically shut down.

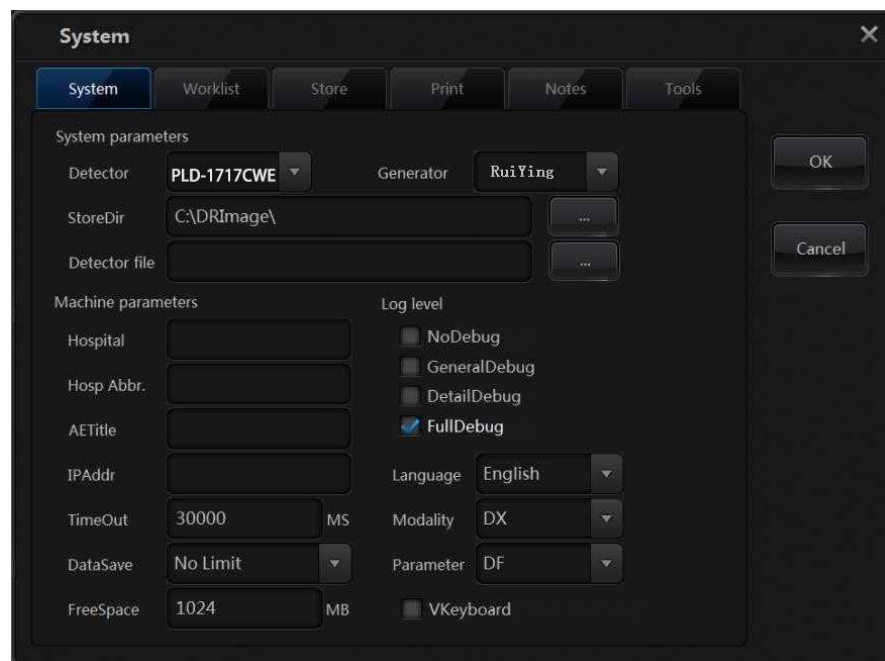


Unauthorized messages

## 5.5 Software Setting of Image Acquisition Workstation

### 5.5.1 Software Setting

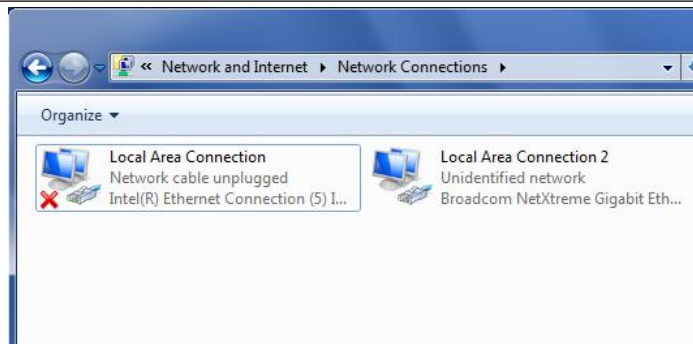
Dectctor select “PLD-1717V”, and generator select”RuiYing”, as shown below:



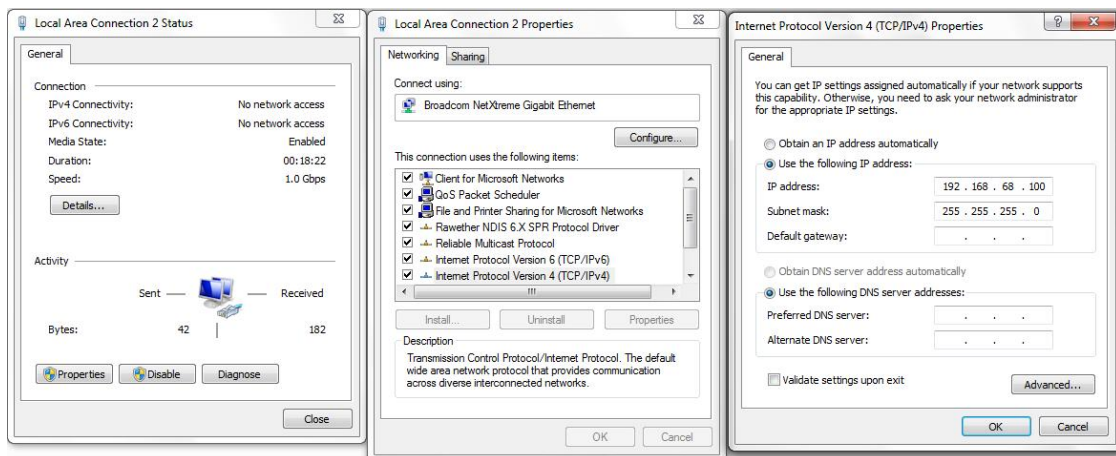
: Select the language of FPD Tools.

### 5.5.2 Workstation IP Settings

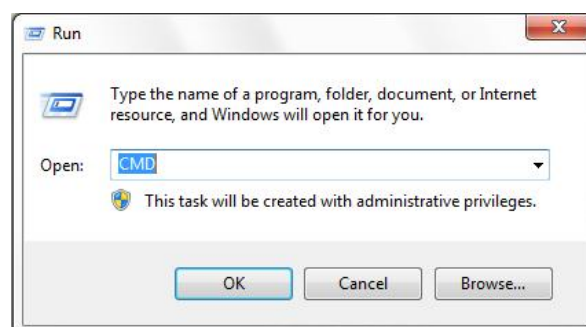
1. Insert the network cable into the socket of the independent Gigabit Ethernet card.
2. Select the “Start Menu “,select “Control Panel” ,select “network and Internet”,select “Modify adapter settings”.



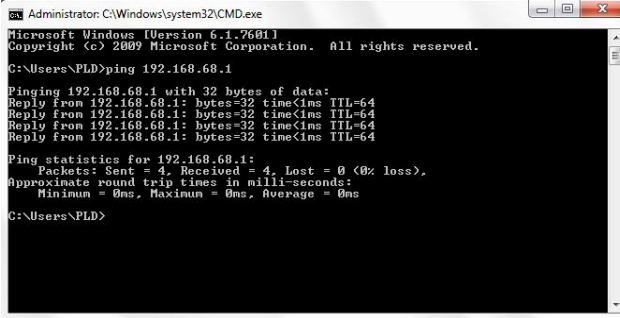
- In the "network connection", click the "local connection 2" of the independent network card with the right mouse button, select "attribute", select "Internet protocol version 4 (TCP/IPv4)", click "attribute", select "use the following IP address", set up "IP address" as "192.168.68.100", "subnet mask" set to "255.255.255.0", click "OK" to save the settings.



- Select the "Start Menu", input "CMD" in the "search box", press the keyboard "Enter" button, and play the "run window".



- Input "Ping 192.168.68.1" in the "running window" and press the keyboard "Enter" key.



```

Administrator: C:\Windows\system32\cmd.exe
Microsoft Windows [Version 6.1.7601]
Copyright (c) 2009 Microsoft Corporation. All rights reserved.

C:\Users\PLD>ping 192.168.68.1

Pinging 192.168.68.1 with 32 bytes of data:
Reply from 192.168.68.1: bytes=32 time<1ms TTL=64
Reply from 192.168.68.1: bytes=32 time<1ms TTL=64
Reply from 192.168.68.1: bytes=32 time<1ms TTL=64
Reply from 192.168.68.1: bytes=32 time<1ms TTL=64

Ping statistics for 192.168.68.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\Users\PLD>

```

6. As shown in Figure, the "run window" shows the state of the successful connection of the tablet, which is normal. Otherwise, re check the connection of the network cable and the setting of the NIC.

### 5.5.3 Router Settings

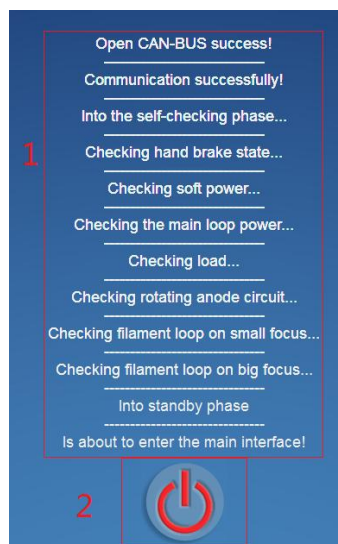
- 1) Referring to the file delivered with the router, enter the router configuration interface.
  - 2) Select dynamic IP as the networking mode.
  - 3) Disable 2.4g /5G dual frequency integration.
  - 4) Disable or shield 2.4G wifi signal.
- Remark: If this option is not available, follow the steps below to set the 2.4g signal.
- 5) Set the 2.4g signal
    - a. The name set as“useless\_2.4G”;
    - b. The password set as“A12345678”.
  - 6) Set the 5G signal
    - a. The name set as“machine number\_5G”;
- Remark: if the machine number is 73D22043, the 5G signal name set as“73D22043\_5G”.
- b. The password set as“123456789”, save settings.
  - 7) Enabling Wi-Fi FI6 (if available)
  - 8) Set the LAN IP address as: 192.168.68.10.This IP address will be used for the next login to the router settings page.
  - 9) Set the router login password as: Pld12345678 (case-sensitive)
  - 10) Enable the DHCP service. The start IP address is: 192.168.68.1
  - 11) Save the Settings and restart the router.

## 5.6 Calibration of Generator

### 5.6.1 Enter and Debug the High Voltage Generator

Refer to “6.1 Symbol Description on Device” to start up. After the workstation is powered on, open the HVSDK host computer software in the workstation. After the power-on program is completed, the software interface will display the high voltage to enter the normal working state. If a system failure is found at this time, an error code dialog box will pop up on the software interface to indicate the problem.

### 5.6.2 Software Interface

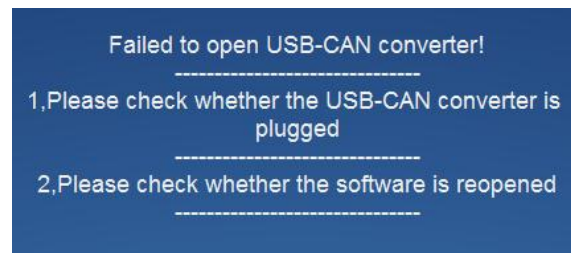


The name of each element on the self-test interface and its role:

#### 1. Self-test process information display area

- (A) High voltage generator works normally and is turned on for the first time: it shows the process of self-test of the system.
- (B) High voltage generator is working normally, not the first time it is turned on: it shows the current system status.
- (C) High voltage not connected: only "CAN open successfully" is displayed.
- (D) Open the software repeatedly: display the following information.

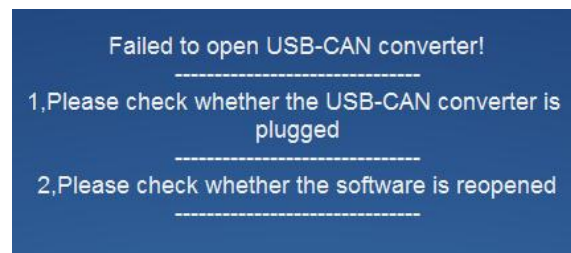




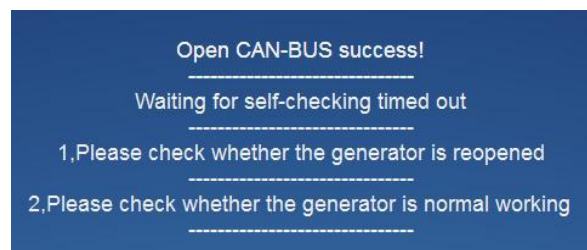
After pressing the "OK" button, the software enters the self-test interface, and the prompt appears again, indicating that the last software is running. At this time, please close all running HVSDK.exe, and then open the software to run normally.

Note:

(A) If the software does not open repeatedly, when the following prompt appears when opening the self-test interface, please press the software element 2 buttons (close button), then unplug the CAN controller communication line and plug it in again to open the software. Normally enter the self-test process.



(B) If the software is opened, the following information is displayed on the self-test interface, and there is no change, indicating that the CAN controller is connected normally, but the high voltage communication fails, which may be caused by high voltage failure and high voltage abnormality.



## 2. Close software button

Press this button to exit the software while the software is running.

Note:

(1) Turn on the high voltage. If the high voltage is reported incorrectly, the program will pop up the error code prompt box.

(2) The software will automatically enter the SDK interface only after the high-voltage

self-test ends normally.

### 5.6.3 SDK Service Mode Interface

#### Manual X-ray tube calibration interface

The left side of the service mode is the menu bar and the right side is the sub-interface. The service mode defaults to manual X-ray tube calibration.



Description of each element on the interface

#### (1) Preparation and exposure lamp:

The status of this light during standby:



Press the first brake (prepared), the state of the light when the generator is ready :



The status of this light when the second brake (exposure) is pressed:



The state of the light after the exposure is over:



**(2) Manual X-ray tube calibration switch button:** there are two states, default and pressed. When this button is pressed, the sub-interface is switched to the manual X-ray tube calibration interface.

**(3) Automatic X-ray tube calibration switch button:** there are two states, default and

pressed. When this button is pressed, the sub-interface is switched to the automatic X-ray tube calibration interface.

**(4) Configuration button:** there are two states, default and pressed. When this button is pressed, the sub-interface is switched to the configuration interface.

**(5) System date and time display**

**(6) Display area of X-ray tube heat capacity percentage:** after one or more exposures, the current X-ray tube heat capacity percentage will be displayed.

**(7) Filament adjustment (subtraction) button:** click this button, the filament value is reduced by 1. The filament value will be further decreased when long press this button. There are three states: default and mouse stay and being pressed.

**(8) Display area of filament value:** display current filament parameter value with the decimal point at 0. When adjusting the KV or MA value, the filament parameter value will change accordingly.


**(9) Filament adjustment (add) button:** click this button, the filament value is added by 1. The filament value will be further added when long press this button. There are three states: default and mouse stay and being pressed.

**(10) KV adjustment (subtraction) button:** click this button, the KV value is reduced by 1. The KV value will be further decreased when long press this button. There are three states: default and mouse stay and being pressed.

**(11) Display area of KV value:** display current KV parameter value with the decimal point at 0, and the range is [40,150].

**(12) KV adjustment (add) button:** click this button, the KV value is added by 1. The KV value will be further added when long press this button. There are three states: default and mouse stay and being pressed.

**(13) Display area of KV average value:** display the average KV sampling data with the decimal point at 2.

Note: "Error" will be displayed here when the simulated sampling Error value exceeds 40%. 

**(14) Display area of KV error percentage value:** After receiving exposure once, the system will sample KV data, calculate the average value of the data and analyze the error.

Display value algorithm for this region:

$((\text{KV average display value} - \text{set value}) / \text{set value}) * 100\%$  with 1 decimal point.

Note: "Error" will be displayed here when the simulated sampling Error value exceeds 40%. **Deviation: Error**

**(15) MS adjustment (subtraction) button:** click this button, the MS value is reduced by 1. The MS value will be further decreased when long press this button. There are three states: default and mouse stay and being pressed.

**(16) Display area of MS value:** display current MS parameter value with the decimal point at 2.

**(17) MS adjustment (add) button:** click this button, the MS value is added by 1. The MS value will be further added when long press this button. There are three states: default and mouse stay and being pressed.

**(18) MA adjustment (subtraction) button:** click this button, the MA value is reduced by 1. The MA value will be further decreased when long press this button. There are three states: default and mouse stay and being pressed.

**(19) Display area of MA value:** display current MA parameter value with the decimal point at 1.

**(20) MA adjustment (add) button:** click this button, the MA value is added by 1. The MA value will be further added when long press this button. There are three states: default and mouse stay and being pressed.

**(21) Display area of MA average value:** display the average MA sampling data with the decimal point at 2.

Note: "Error" will be displayed here when the simulated sampling Error value exceeds 40%. **AVG. MA: Error**

**(22) Display area of MA error percentage value:** After receiving exposure once, the system will sample MA data, calculate the average value of the data and analyze the error.

Display value algorithm for this region:

$((|MA \text{ average display value} - \text{set value}|) / \text{set value}) * 100\%$  with 1 decimal point.

Note: "Error" will be displayed here when the simulated sampling Error value exceeds 40%. **Deviation: Error**

**(23) Display area of KV analog waveform:** after a manual exposure, this area will show the relation between sampling KV and exposure time. The ordinate is sampling KV, and the abscissa is exposure time. Click the waveform and pull it to the right. The waveform becomes larger and the mouse is restored to the left waveform.

**(24) Display area of MA analog waveform:** after a manual exposure, this area will show the relation between sampling MA and exposure time. The ordinate is sampling MA, and the abscissa is exposure time. Click the waveform and pull it to the right. The waveform becomes larger and the mouse is restored to the left waveform.

**(25) System log button:** when this button is pressed, the sub-interface is switched to the system log interface.

**(26) Display area of system communication information:**

Display when the system is working normally:

the system is working correctl

"High pressure disconnected!" is displayed when high-pressure is closed"

"Communication line is disconnected!" is displayed when the communication line of CAN controller is disconnected.

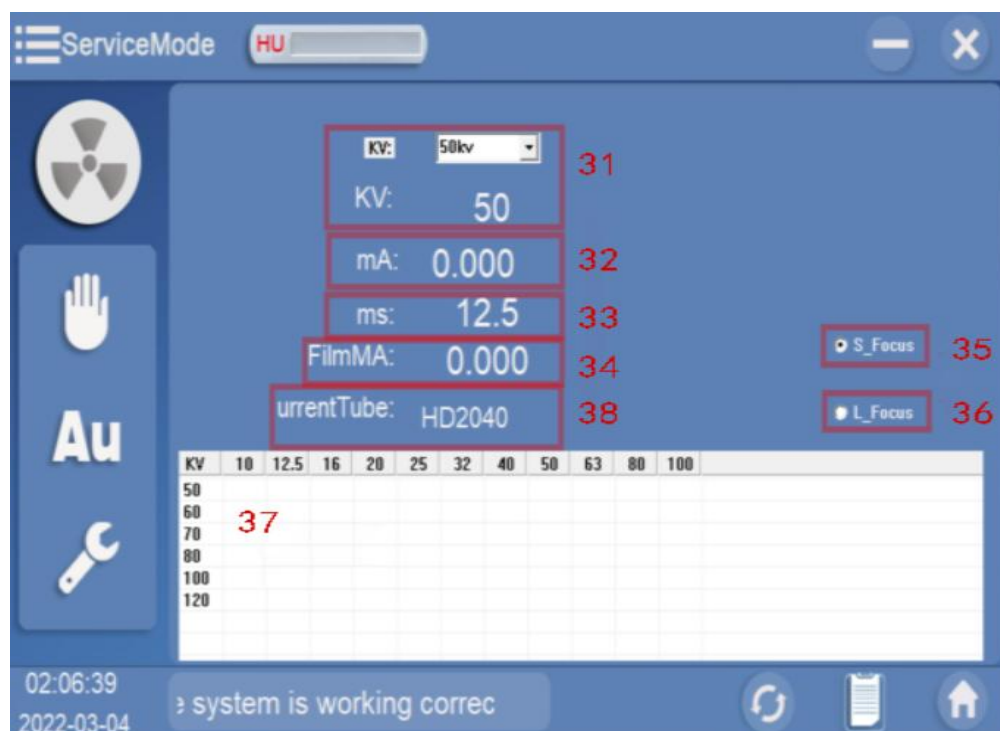
**(27) Minimize software button:** when press this button, the software will be minimized to the operating system taskbar and the pallet bar in the lower right corner of the system. Click the taskbar to restore the software.

**(28) Exit the program button:** when press this button and the program will exit completely.

**(29) Error reset button:** only reset errors at the beginning of EL

**(30) Return to the SDK button:** when this button is pressed, the service mode is exited and the software enters the SDK interface.

### Manual X-ray tube calibration interface



---

**(31) KV gear currently being calibrated:** represents the KV gear currently being calibrated, and this area cannot be manually adjusted

**(32) Display area of current filament current value:** this area cannot be manually adjusted to display filament current value

**(33) Display area of current exposure time value:** this area cannot be manually adjusted to display exposure time

**(34) Display area of current X-ray tube filament current value:** this area cannot be manually adjusted to display filament current value

The algorithm is as follows: filament analog value = filament value \*2/4096.0\*5.0

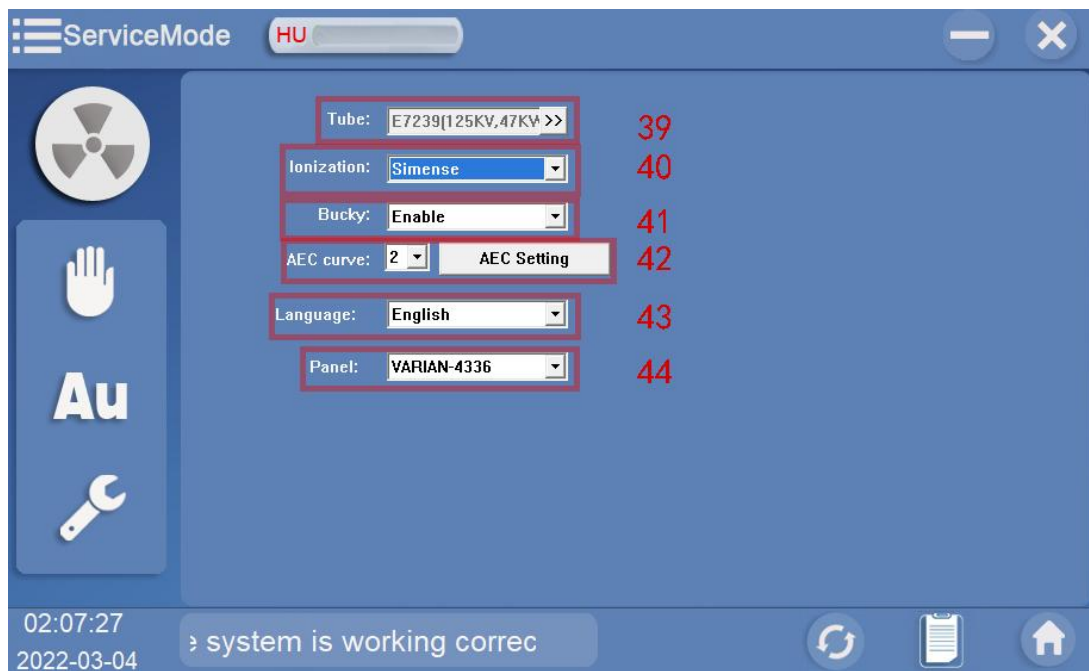
**(35/36) Small / Large focus selection box.**

When and only one of them can be selected, the selection of small focus indicates that the MA of the calibration is 100MA or below, and the selection of large focus indicates that the MA of the calibration is 125MA or above.

**(37) Prompt for the success of the automatic calibration of the corresponding shift position:** the starting KV of the automatic calibration is fixed at 50KV. After setting the focus of the size, press the first gear of the hand brake, and then press the second gear of the hand brake and do not release it. At this time, enter the automatic calibration process. Starting small focus, for example, high voltage generator will continuous exposure, since 50 kV and adjusting filament value, so that the filament current direct or close to 10 MA, the elements of 40 corresponding gear (50 kV, 10 MA) region shows "tick", said the end of the calibration, after the system to continue a (50 kV, 12.5 MA) filament calibration, until the 120 kV, 100 MA calibration is completed. If the calibration is completed, the system will pop up the completion prompt dialog box and press ok. If the hand brake is released during the process, the software will pop up the inquiry dialog box and ask whether to continue. If you press ok, you will stay in the current calibration status. If you press cancel, you will exit the automatic calibration interface and return to the manual calibration interface.

**(38) Current selected tube model**

## Configuration interface



Tube 45				
HD1020	HD2040	HD3050	XD3050	E7242
E7252-H	E7252-L	RAY12	RAY14-H	RAY14-L
RAD-14	RAD-12	A192(80KW)	RAD-8(47KW)	A132(63KW)
E7239(125KV,47KW)	E7240(150KV,20KW)	E7254(150KV,80KW)	E7255(150KV,80KW)	E7299(150KV,40KW)
E7813(150KV,80KW)	E7823(150KV,80KW)	E7846(50-130KV,32KW)	LQ16-XA2(2040/125)	XH01(2040/150)
H1074(125/40KW)	H1075(150/40)	H1076(125/50)	H1077(150/32KW)	H1080(150/50KW)
H1083(125/32KW)	H1086(150/50)	XD57-2050-150	XD52-3050-125	XD52-3050-150
E7876				

Description of each element on the interface

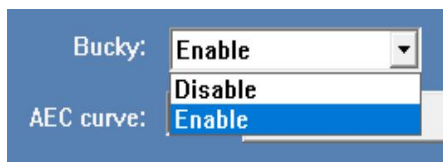
**(39) X-ray tube selection box:** click the arrow to the right of this box and the X-ray tube selection table will pop out (element 48).

**(40) Select the drop-down box for ionization chamber type:** click this drop-down box, the following two types of ionization chamber types will pop up: AID/ Claymound, Simense, and the selection box after clicking a certain type shows the currently selected ionization chamber type.

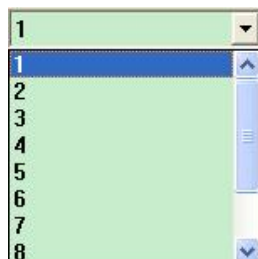


**(41) Filter selection drop-down box:** click this drop-down box and the filter selection box will pop up. Click a certain type.





**(42) AEC curve select drop-down box:** click this drop-down box, will produce 11 AEC curves, and then click a certain type.



**(43) Select system language, currently English by default**

**(44) Select Drop Down List Box of Treadmill mode:** Press Select Drop Down List Box, there will appear 7 kinds of Treadmill modes as followed:



**(45) X-ray tube selection button**

**Note: The parameters list of each type of X-ray tube is as follows:**

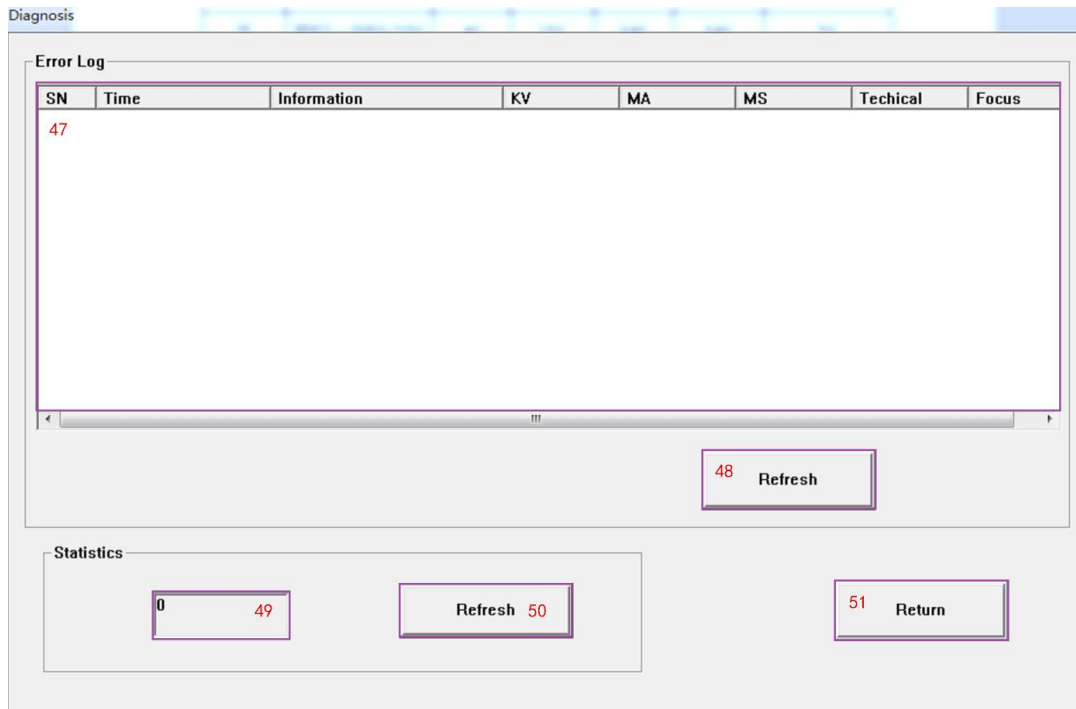
Number	X-ray tube	Minimum KV	Maximum KV	Maximum m mA	Maximum mAS	Maximum power (KW)
1	HD1020	40	125	320	320	20
2	HD2040	40	125	400	400	32
3	HD3050	40	125	640	640	50
4	XD3050	40	150	640	640	50
5	E7242	40	125	640	640	47
6	e7252-h	50	150	1000	1000	77
7	e7252-l	50	150	640	640	47



8	ray12	40	150	640	640	50
9	ray14_h	40	150	1000	1000	77
10	ray14_l	40	150	640	640	50
11	raD14	40	150	1000	1000	77
12	raD12	40	150	640	640	50
13	A192	40	150	1000	1000	80
14	RAD-8	40	150	640	640	47
15	A132	40	150	800	800	63
16	E7239	40	125	640	640	47
17	E7240	40	150	320	320	20
18	E7254	40	150	1000	1000	80
19	E7255	40	150	1000	1000	80
20	e7299	40	150	500	500	40
21	E7813	40	150	1000	1000	80
22	E7823	40	150	1000	1000	80
23	E7846	50	130	400	400	32
24	LQ16--2040/150	40	125	500	500	40
25	LQ16-2040/150	40	150	500	500	40
26	H1074	40	125	500	500	40
27	H1075	40	150	500	500	40
28	H1076	40	125	640	640	50
29	H1077	40	150	400	400	32
30	H1080	40	150	640	640	50
31	H1083	40	125	400	400	32
32	H1086	40	150	640	640	50
33	XD57-2050/150	40	150	640	640	50
34	XD52--3050/125	40	125	640	640	50
35	XD52--3050/150	40	150	640	640	50

**(46) X-ray tube model**

## System log interface



Description of each element on the interface

**(47) System error log table:** this table displays all error information stored in the error file (errlog.log) of the system, including error time, information, KV, MA, MS, exposure mode and focus.

**(48) Refresh button:** press this button and the software will read the current latest error information.

**(49) Total times of high pressure exposure:** show total times of high pressure exposure.

**(50) Refresh button:** press this button and the software will read the current total number of exposures.

**(51) Return button:** press this button to push the system log interface back to the service mode interface.

### 5.6.4 Final Inspection

High voltage generator adjustment of the equipment must be approved by the factory or factory technician, adjustment method and related technical questions, please contact the

---

supplier.

## 5.7 X-ray and Image Adjustment

### 5.7.1 X-ray Adjustment

#### 1. X-ray beam perpendicularity adjustment

##### A. Adjustment of perpendicularity of X-ray beam of radiography table

Press the button on tube stand cow or holding the button on handle box, rotate the tube stand to  $90^\circ$  and rotate the flat panel detector to  $0^\circ$ , dispatch collimator splitter opening to maximum, puts collimating bucket in the center of flat panel detector. The collimation barrel was observed at the edge of the display circular image by the method of exposure. If the edge size is uniform (the difference between the maximum and minimum thickness of the projection edge is less than 1mm), the X-ray focus is perpendicular to the flat detector. If uneven, adjust the tube to move to one side with thick edges until uniform.

##### B. Adjustment of X-ray beam perpendicularity of vertical bucky stand

After adjusting the radiography table, adjust the vertical bucky stand base so that the X-ray focus is perpendicular to the plate detector and the center coincides.

Tube beam splitter rotate  $90^\circ$ , limited to the limit of beam splitter opening to maximum, the collimating tube placed in the flat panel detector is center, The collimating cylinder is observed at the edge of the display circle by means of exposure, if the edge size uniform (projection edge thickness is the difference between the maximum and minimum 1 mm or less) suggests that X-ray focus is perpendicular to the flat panel detector. If not, adjust the vertical bucky stand base to the thick edge of the side, until uniform.

C. The collimation of the X-ray beam should be calibrated at least once a year; If the X-ray tube assembly is replaced, the collimation of the X-ray beam should be adjusted after replacement.

#### 2. X-ray tube component/collimator - detector alignment

Placed 100 x100 square iron box in the center of the detector, adjust the limit of the collimator to X and Y to open slightly larger than the iron box (5 mm or so), to collect images through the detector exposure. Whether the opening frame of the collimator observed on the display is consistent with the clearance around the iron frame placed, otherwise, adjust the relevant positions of screws and lead blades between the x-ray tube and collimator to make

the clearance tend to be consistent (error is about 2mm).

## 5.7.2 Collimator Adjustment

There is a 3P aviation plug on the collimator, which is the power lamp line of the collimator. Please ensure that the aviation plug is well installed before use. The parameters of the collimator have been adjusted before leaving the factory, and should be further adjusted after installation and before use to eliminate errors caused by improper installation.

### 1. Collimator X-ray field - field adjustment

Adjust the X-direction and Y-direction openings of the collimator, and the light field on the detector is slightly larger than the iron frame (about 5mm). Observe whether the light field frame of the collimator is consistent with the clearance around the placed iron frame; otherwise, adjust the position of the field lamp inside the collimator, so that the clearance tends to be consistent (the error is about 2mm).

### 2. Adjust the opening size of collimator

Adjust the opening size of the collimator by rotating the opening and closing knob of the collimator, the collimator can be opened and closed on the X-axis and Y-axis, so as to adjust the opening size of the collimator.

## 5.7.3 Flat Panel Detector Adjustment

Ensure that the light path between the tube and the plate is free from any occlusion or interference (beam limiter and bed panel are required to exist, and the filter grid is to be removed). Select "offset calibration" in routine calibration under the "calibration" menu.

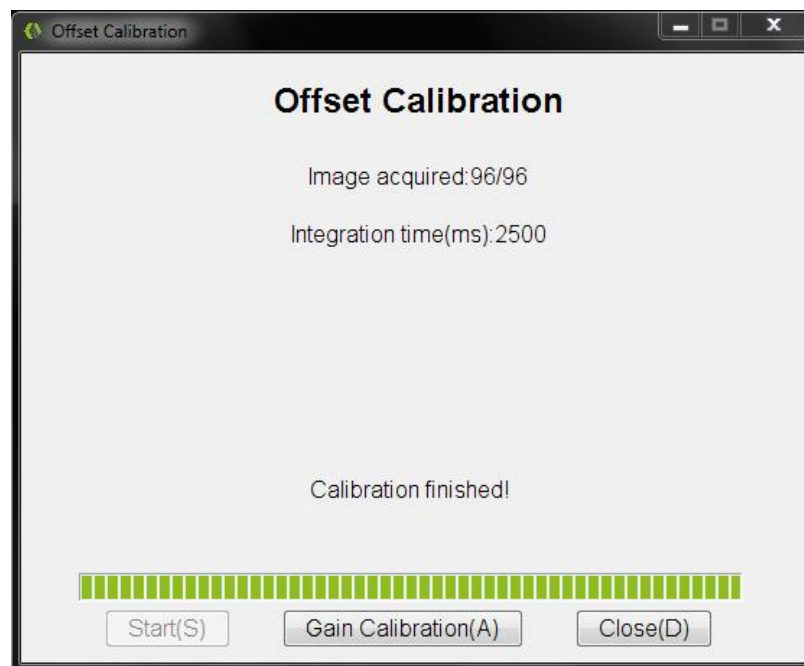
Select "start" button in the pop-up offset calibration dialog box, and then start the plate offset correction, as shown in the figure below.



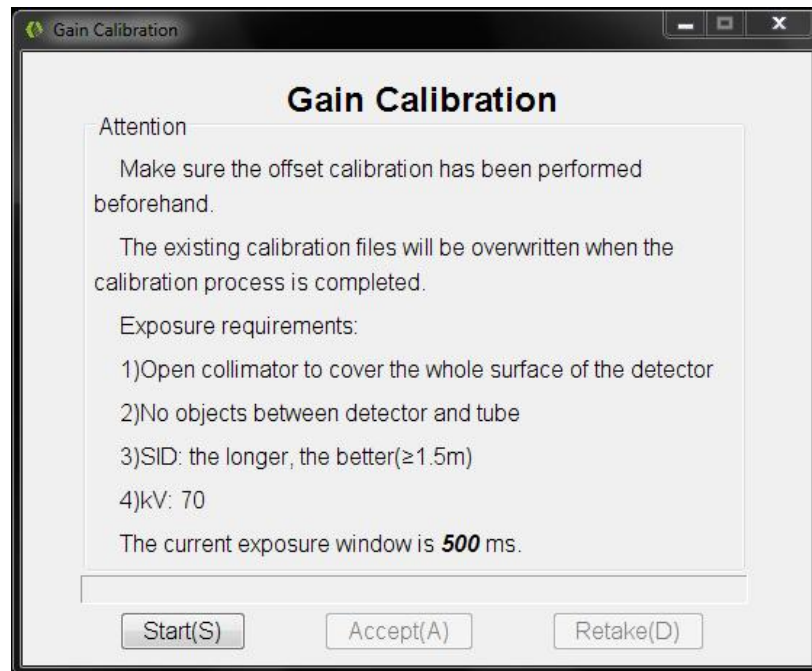
At this time, the software will automatically perform offset correction, and the correction process will be displayed in the offset calibration dialog box, as shown in the figure below.



Until the offset correction is completed, the dialog box will prompt "Calibration finished!" At this time, click the "Gain Calibration" button to enter the Gain Calibration interface, as shown in the figure below.



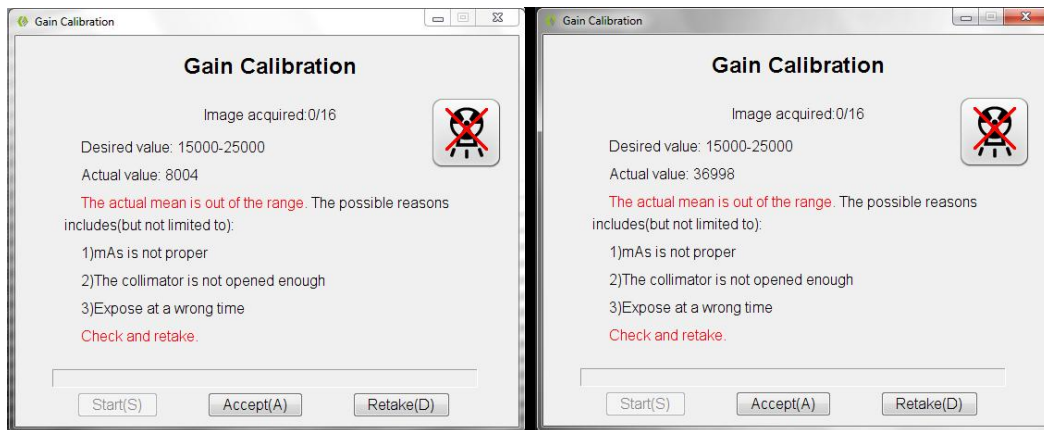
At this time, the software enters the gain calibration interface. After confirming the environmental requirements according to the prompts, click "start" to conduct gain calibration, as shown in the figure below.



Set the high voltage to 70KV ( $\pm 1$ KV can be fine-tuned if adjusting mAs always fails to meet the requirements), select appropriate mAs for exposure, and the actual average value of the images collected during the exposure test is around 20000, as shown in the figure below.

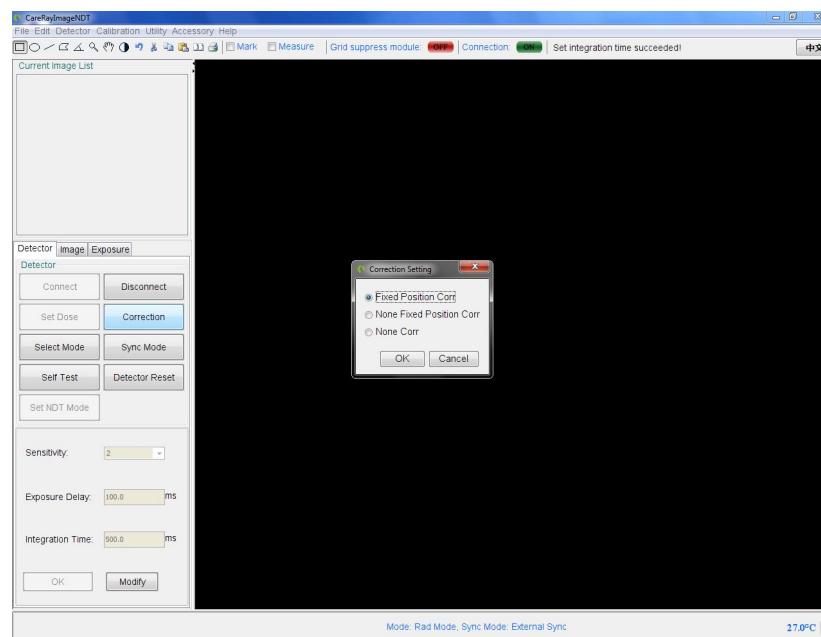


If the selected dose is inappropriate, the actual mean value will be much lower than the expected mean value or much higher than the expected mean value. At this time, click the "retake" button to adjust the dose and re-expose, as shown in the figure below.

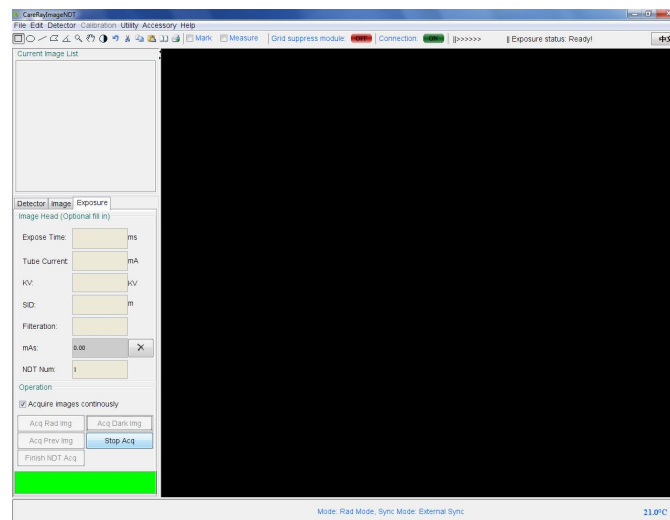


Until the calibration of 16 images is completed, click the "finish" button to complete the plate calibration when prompted that the calibration has been completed.

Now restart the CarerayImageNDT V\*.\*.\* application, adjust the setting correction option to "fixed position correction", click "OK", and save the Settings, as shown in the figure below;




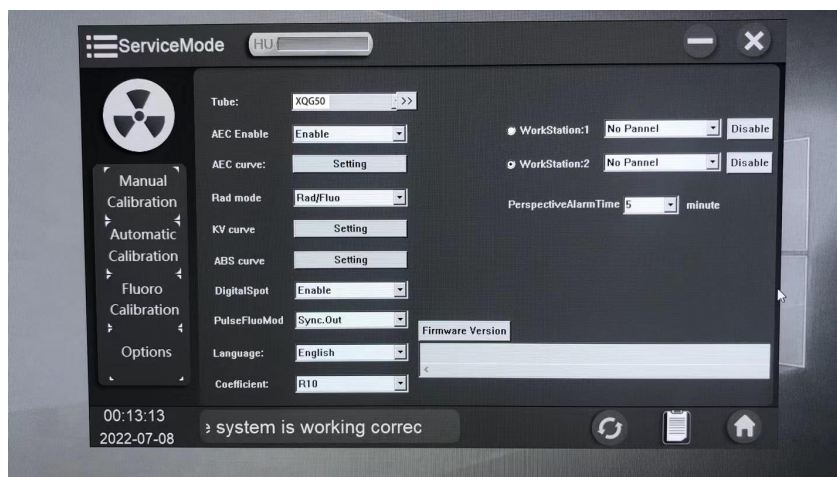
Select the menu of "operation of drawing", select the buttons of "continuous drawing" and "image acquisition by exposure", and the tablet is ready to start image acquisition, as shown in the figure below; Select appropriate low dose for exposure, and check whether the acquired image is uniform in brightness, free of stains and bad spots, and then complete the correction.



## 5.8 AEC Calibration



Click the  button in the lower right corner of the MAIN interface of SDK software, open the AEC Settings and calibration dialog box, select the "AEC Curve" menu and click the setting option, as shown below:



select the "Film Screen Calibration" menu, Fill in "4.5" in the corresponding number box of 75KV as shown in the figure; Click "Save" on the right to save the Settings, as shown below;



Double-click the DFOC icon on the desktop to open the DFOC collection workstation software and create a patient case.

Rotate the table so that the table is placed horizontally and covered with pearl wool. Place the 20CM water mold on the pearl wool and adjust the tabletop so that the field light shines on the center of the water mold (ensure the SID is 1 meter).

Open the collimator field to the maximum, use AEC mode, adjust the generator incidence dose to 75kV, 320mA, 320ms, exposure.

View the EXI value of the exposed image. If the EXI value of the image does not reach or exceed 3000( $\pm 3\%$ ), then it is necessary to adjust the R11 potentiometer on the HIGH frequency generator ionization chamber plate (AEC BOARD 737998) to make the EXI value of the exposed image reach 3000(clockwise rotation of the potentiometer is to reduce the EXI value; Otherwise, increase the value of EXI.)

Note: after 75KV calibration, it is forbidden to adjust potentiometer R11 when other KV is calibrated .

Calibrate the generator parameters with reference to the data in the following list. The difference is that the data to adjust the EXI value is set by adjusting the high frequency generator control software.

50KV	15CM H <sub>2</sub> O	320MA	3000
55KV	15CM H <sub>2</sub> O	320MA	3000
65KV	15CM H <sub>2</sub> O	320MA	3000
85KV	20CM H <sub>2</sub> O	320MA	3000
95KV	20CM H <sub>2</sub> O	320MA	3000
110KV	25CM H <sub>2</sub> O	200MA	3000

130KV	25CM H <sub>2</sub> O	200MA	3000
-------	-----------------------	-------	------

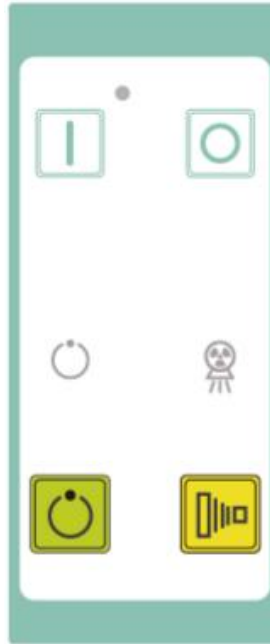
## 5.9 Final Confirmation Inspection


The high voltage generator of this equipment must be tested by the factory or the factory approved technical personnel. Please contact the factory or the factory approved technical personnel for debugging methods, tube training and related technical problems.


## CHAPTER6 OPERATION OF THE EQUIPMENT


### 6.1 The Description of the Symbol on the Device

The on/off button of the device is on the console control box, as shown in figure.




1. Power on: 

2. Power off: 





Power on: Press the "" button on the generator control panel to start the power supply of the whole machine. Turn on the generator, image acquisition workstation computer

Power off: After shutting down the image acquisition workstation, close the PC, and then

press the "" button on the generator control panel to turn off the power supply of the whole machine.

## 6.1.1 Generator Operation Panel and Symbol Description




1.  Perspective indicator light.
2.  Exposure indicator light
3.  Or the first gear of hand brake: prepare button.
4.  Or the second gear of hand brake: exposure button.

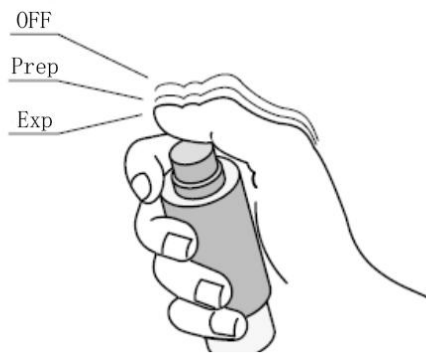
### Preparation, X-ray exposure and exposure indicator

Press the first gear (prepare) of the hand brake on the operating table, and when the

generator is ready,  ready indicator lights up.

Press the second gear (exposure) of the hand brake on the operating table, and when the

generator emits X-ray,  the exposure indicator lights up and it also buzzing to indicate the exposure process. ◦



You can use the first gear of hand brake (ready) and the second gear of hand brake (X-ray exposure) photographic exposure with two hand brakes.

Use the dot film controller on the corresponding dot film device for dot film exposure.

During the exposure process, the preparation and exposure indicator light indicate the exposure status.

X-ray hand brake button has three positions: hand brake release, the first gear of hand brake and the second gear of hand brake.

Press the first gear of hand brake (ready), when ready, press the second gear of hand brake (exposure).

Ready: press the first gear of hand brake; prepare to select the X-ray tube for exposure. When the X-ray tube is ready and there is no interlock failure or system failure, the preparation indicator light on the generator control box will be lit.

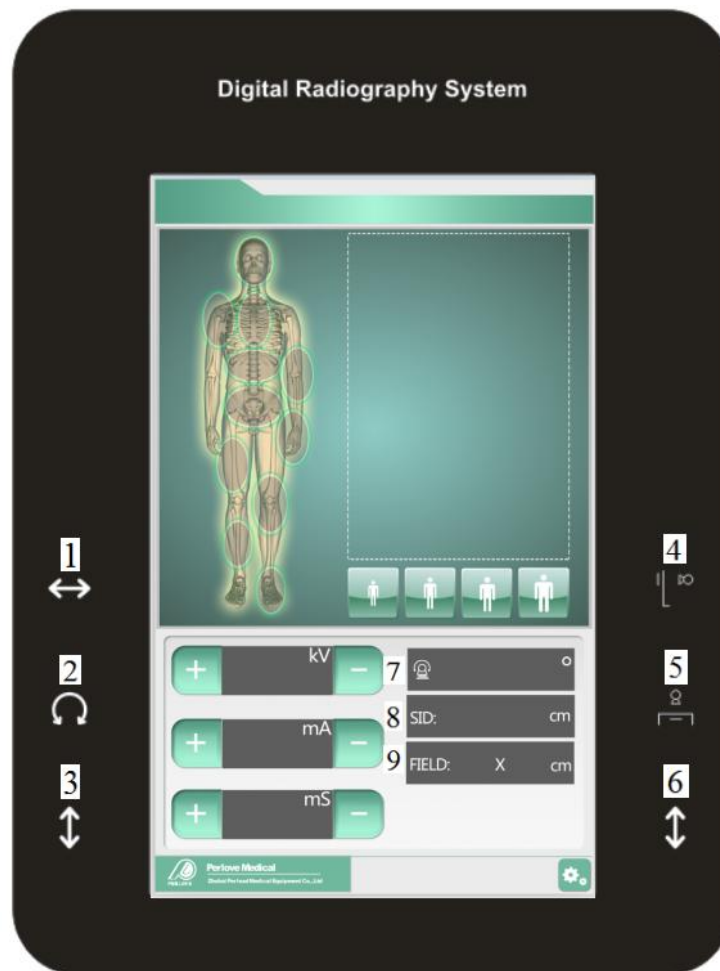


*After pressing this button, the following functions will be activated:*

- The anode rotates.
- Filament current switches from standby to selected mA.

## 6.1.2 Radiography Table Operation Panel and Symbol Description

### 1. Bullhead Assembly Panel



- 1-Tube up button      2-Tube down button  
 3-Unlock button for column longitudinal movement      4、5-Alternate button  
 6-Tube rotation unlock key      7-Indication of tube rotation Angle  
 8-Indication of SID      9-Open area of beam limiter

Figure 6-2 Operation Panel

## 2. Operating Instructions

1) Longitudinal movement: press the unlock key of longitudinal movement, the brake of longitudinal movement will be released, and the X-ray source component can be moved along the table

2) Move up and down: Press the up or down button to move the X-ray source component up and down along the pillar .

3) Rotation around the transverse arm: press the rotation unlock key, and the rotating brake is released to rotate the X-ray source component around the transverse arm. X-ray source components are locked at  $0^\circ$  and  $\pm 90^\circ$  with mechanical limits for easy chest

---

radiographs.

4) Column rotation: step down the column rotation block, column can rotate, every  $90^\circ$ , there is a corresponding limit device, so that the rotation lock. When the column is rotated to  $+90^\circ$  or  $-90^\circ$ , the column can be moved horizontally so that the tube can be photographed outside the head or tail end of the table panel, providing convenience for patients with difficulty in moving. When the column is rotated  $180^\circ$ , the patient's cart or stretcher with limited mobility can be placed behind the camera table.

5) Table movement: step on the table movement unlock switch, the table brake release, the table can be moved horizontally and longitudinally.

6) Table lifting: step on the table lifting foot switch, at this time the table can move up or down accordingly.

7) Camera motion:

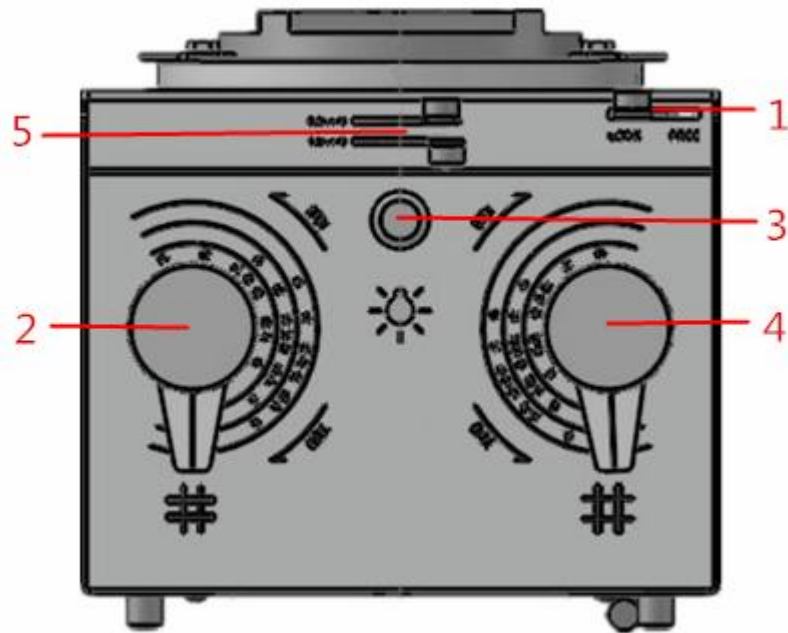
a) The camera and the column follow the movement, move the camera and connect it with the column, the camera and the column move at the same time. This mode of motion can align the focus of the bulb with the center of the filter grid, which is used in the shooting of orthographic X-ray

b) The camera moves alone. Move the camera so that it is disconnected from the column. Then the camera can move alone. This mode of operation is used when taking oblique X-rays.

### **6.1.3 Operation Description of the Collimator**

#### 1. Basic structure

The shape of the collimator is shown in the figure below. The main internal parts are the transmission device, X-axis variable lead blade and Y-axis variable lead blade. The external part mainly consists of a collimator opening and closing knob, a collimator lamp button and an interface connected with an X-ray tube assembly.



- 1—Rotate Release Knob      2—Switch of Collimator (Y axis)  
 3—Collimator Lamp Button      4—Switch knob of Collimator (X axis)  
 5—Filter select pick

Figure 6-3 Collimator Operation Panel

## 2.Instructions

- a) Rotating collimator switch (Y-axis), the knob on the pointer indicating value, according to the size of the need to adjust the longitudinal X-ray radiation field.
- b) Rotational collimator switch (X-axis), the knob on the pointer indicating value, according to the size of the need to adjust the lateral X ray radiation field.
- c) Press the light delay button, the collimator light will be lit within the specified time. When the internal timer starts, the visible light irradiates the field of vision, and the light will turn off automatically after about 30 seconds. At this time, the size indicator of the visible light field formed on the imaging surface is the size of the X-ray field. The reticle projected by the collimator indicates the center of the field.
- d) Collimator rotation: rotate release knob 1 to release the lock of the collimator, which can be done along the axis of the collimator Rotate freely 360°, position and lock at any Angle.

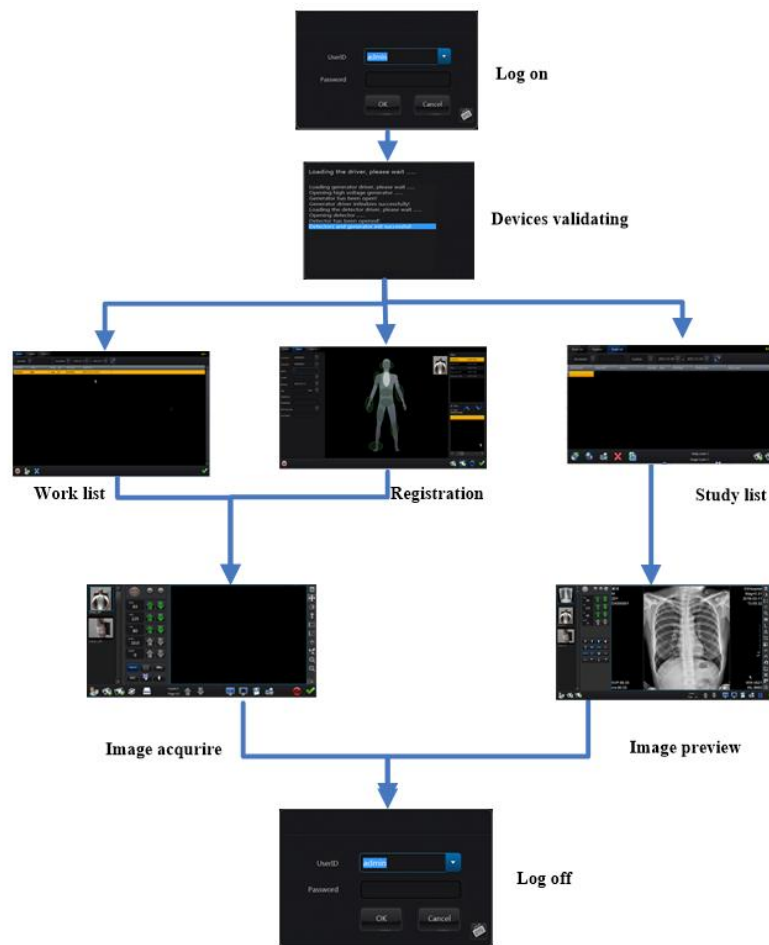
### 6.1.4 Intercom System Instruction

Turn on the console panel's microphone, and the user can speak to the patient.




## 6.1.5 Operation Instruction of Workstation

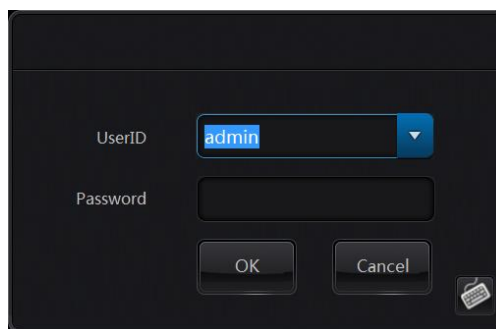
### Work flow of study



### Login

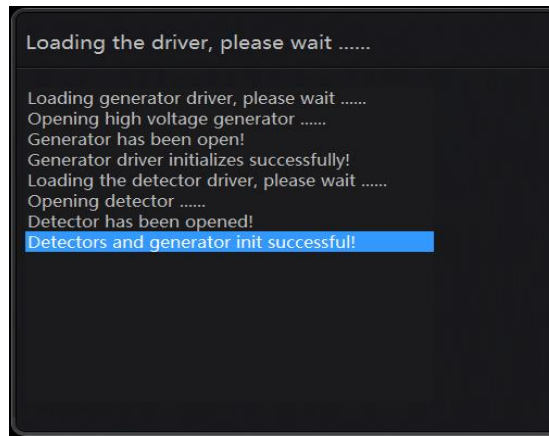
The program will validate the user before entering the system. Input the User ID and Password. (Default User ID / Password: admin/admin). User can also click the keyboard

button  to start or close the virtual keyboard.

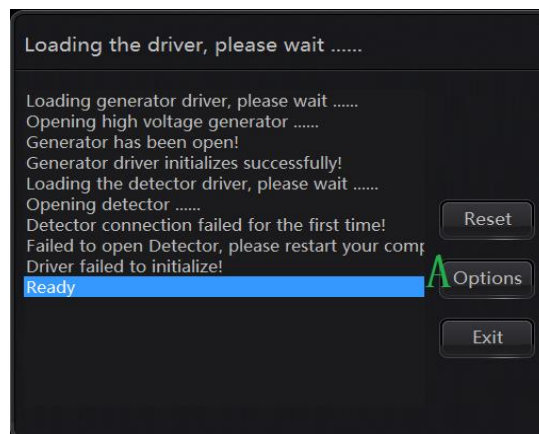


### Devices Validating and Configuration

After successful login, the system will start to load drivers of devices and validate the device initialized successes or failed. There are two stage of loading the drivers: loading drivers for the generator and drivers for the detector.

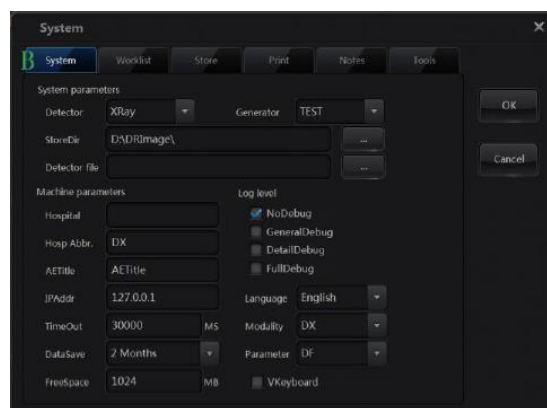


Device initialized successes



Device initialized failed

If failed to initialize the device, then can click “Options” to change the configurations:



Device configuration

If the program didn't connect to generator or detector, please make sure that the related item

set to “TEST” selection. If there’s any trouble with the device, user also needs to reset the items to “TEST” selection in order to enter the system.

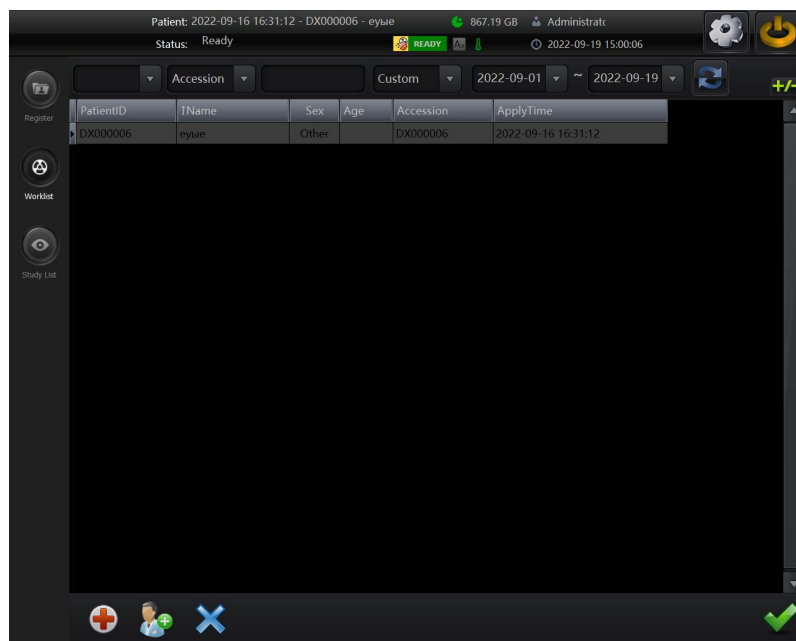
After correct configuration of detector and generator, then click button “OK” to confirm and back to form A, and click button “Exit” to exit the system. After restart, the system will run follow your configuration. Other configuration items will be described in following chapters.

## Study Management

This section mainly manages the patient information, including work list, registration and study list.

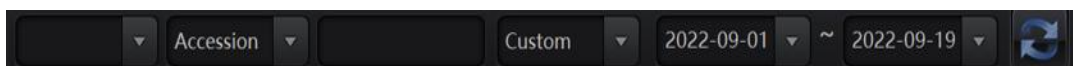
### Work list

The work list displays the list of patient that need to acquiring image. It can query patient data from RIS or registration station follow DICOM 3.0.



Work list





Search Items:



1. Patient ID: user need to input the patient’s id in the textbox, and define the correct date time.
2. Accession: user need to input the patient’s accession in the textbox, and define the correct date time.
3. Name: user need to input the patient’s name in the textbox, and define the correct date time.
4. One day: query the patients’ data in today.

5. Two days: query the patients' data in two days.
6. One week: query the patients' data in a week.
7. Custom: query the patients' data in user defined period.

Once the condition set down, the work list will query data frequently, it can also refresh immediately after the button "Refresh" clicked.


- Emergency:   
Register a patient in emergency with auto generated information.
- Register new Patient:   
Input the patient data and register a new patient for study.
- Delete:   
Delete current selected patient.
- Begin to study:   
Begin to acquiring image of current patient.

## Registration

## Registration

The register is used to record information of a new patient. User can select study protocols through protocol or Item mode.

Accession\*: input the accession number of patient. It will be automatically generated and usually suggest user don't change it. It must unique in the system.

PatientID\*: input the ID of a patient. It will be automatically generated and usually suggest user don't change it. Input PatientID and click , system will automatically fill the patient's information in the text box.

Name: input the name of a patient.

Gender: select gender of a patient. (Male, Female, Other (unknown))

Age: input age of a patient at the age unit of year, month or day.

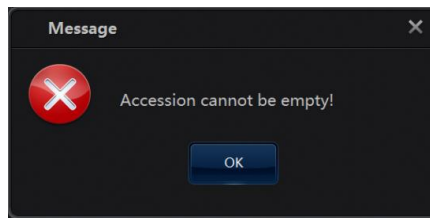
Height (cm): input height of a patient.

Weight (kg): input weight of a patient.

Birthday: select birthday of a patient.

Description: input more comments of a patient.

[Note]The items with "\*" means this item must be filled. If not, there will be a warning message:



Select and Unselect:



Select or unselect a protocol.

Protocol Group:



Add grouped protocols to selected list.

Protocol Item:



Add individual protocols to selected list.

Clear:



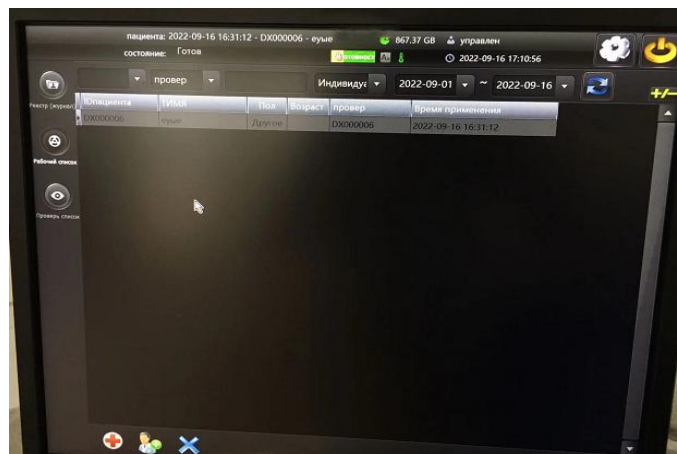
Clear information of current patient.

Begin to study:



Begin to acquiring image of current patient.

## Study List




Study List

It is used to query the information of the patients that finished the study. Same with the work list, the result can be displayed under different condition.

Emergency:



Register a patient in emergency with auto generated information.

Register new Patient: 

Input the patient data and register a new patient for study.

Delete:  Delete current study.

## Image Acquisition and Preview

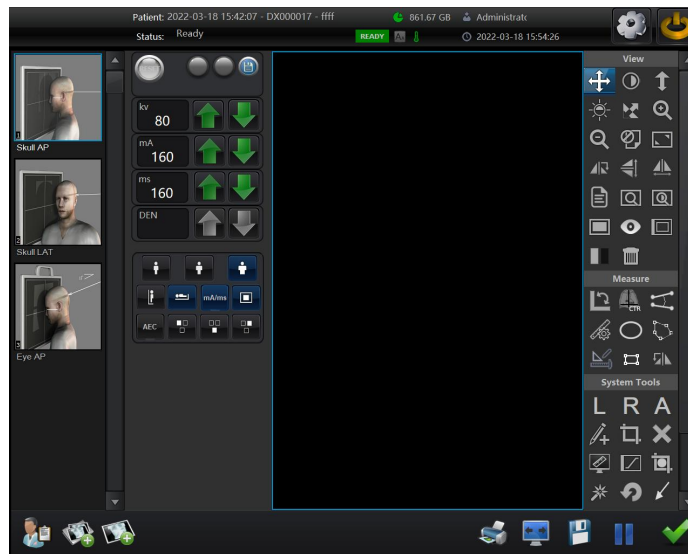







Image Acquisition

Before Image acquisition, the parameters of generator should be property configured, and the trigger mode of detector must be correct. For more information, please read the manual of these devices.

### Image Acquisition

These items are used to work with the generator parameters:

- Choose the study Body size (large, medium, thin, and small) 
- Choose the right position (Wall, Table) 
- Adjust the exposure parameters  Increase or decrease values of KVP, MA and MAS
- Mode of generator.   (May different to some generators) Set mode of generator to mA/ms, mAs or AEC.

### Image Preview

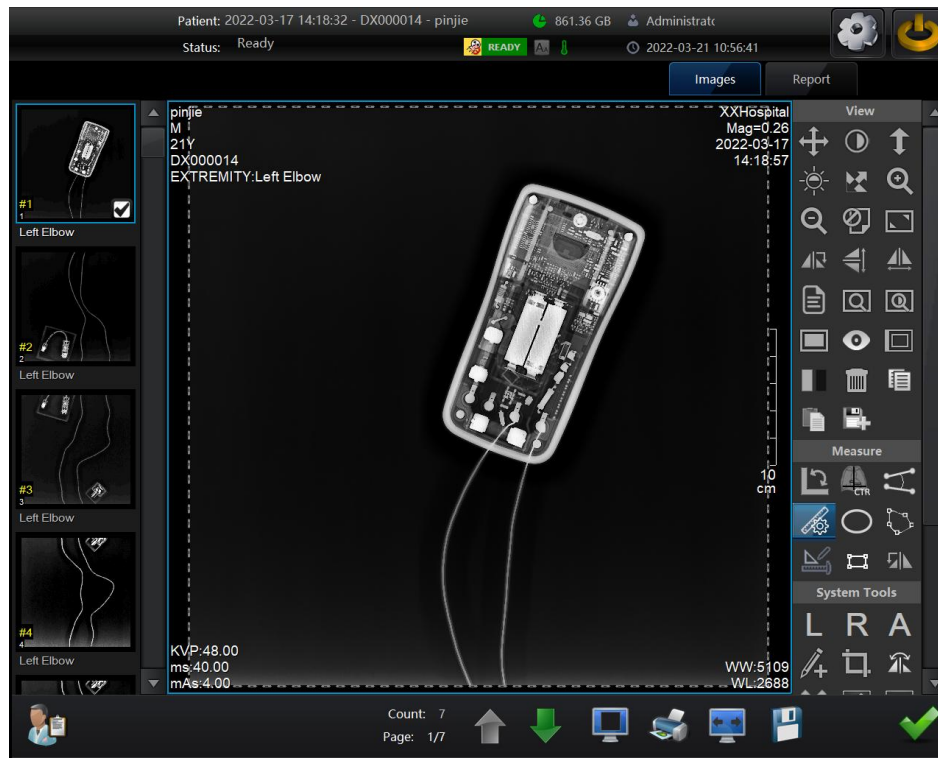


























Image Preview

After acquired an image from detector, the processed image will be displayed. There are many powerful tools for advanced user to take a better view of the image.

### Tools

Tool button	Description	Tool button	Description
	Page Pre/Next		Full Screen
	1X1 Layout		1X2 Layout
	2X1 Layout		2X2 Layout



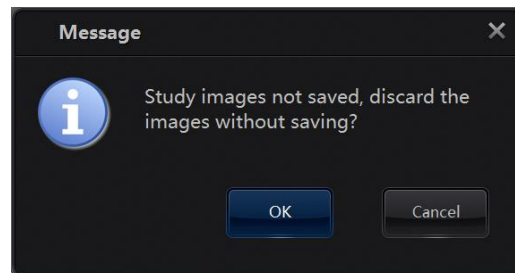
	Save current Image		DICOM Print
	Delete Tool		Reject Image
	Move Image		Window/Level
	Zoom In/Out:		ROI Window/Level
	Histogram WW/WL		Auto WW/WL
	Invert Color		Zoom In
	Zoom out		Full Size
	Screen Size		Mark Left
	Mark Right		Mark Anterior
	Text Edit		Clip Tool
	Image advanced process		Invalid Image
	Rotate 90		Flip H
	Flip V		Reset
	Measure the angle		Measure the length
	Hint of the image		Image stitching
	Point gray value of the image		

End of the study



Drop Study:

Drop all images of current study. If current study has already taken images, then there will be a acquire message:



If user clicks “OK”, then then system will drop all the images and back to the worklist.



Finish & Save:

End current study and save all images to local drive as DICOM files. If successfully, then user can find the study in the studylist.

### Image advanced process

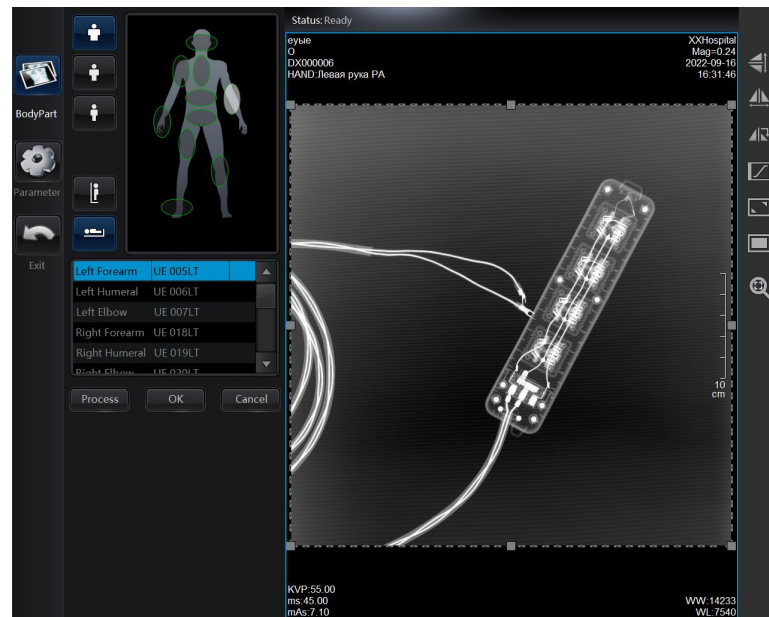
Image advanced process enables the user to conduct more detail process. Click button “Image



Process”.

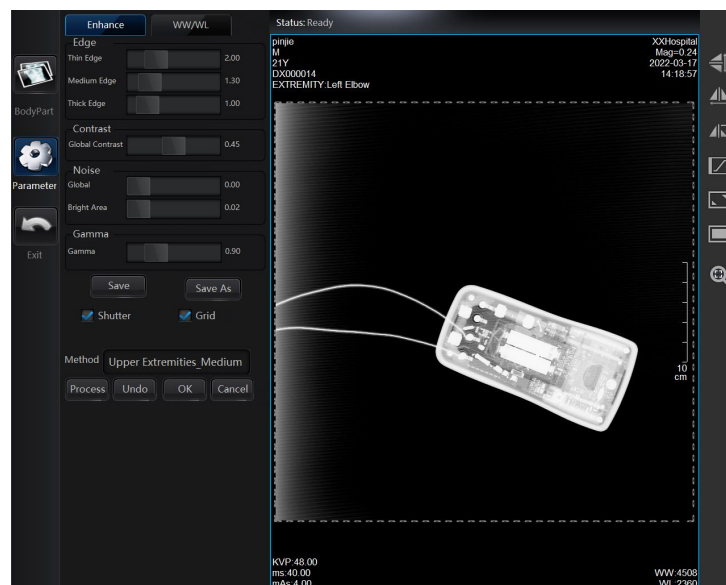


: Parameters related to the body part. User can set the body part, body size and items to select a group of parameters. After click “Process” button, system will display the processed image.



: Detail parameters mode. Before enter the following interface, system will get the default parameter values of each items which is related to the body part. User can directly use these values or reset one or more of them.

- Click “Process” button, system will start the image processing, user will get message at status area.
- Click “OK” button, the processed image will be applied to replace the original image and back to the acquiring or preview interface.
- Click “Cancel” button, system will exit the image advanced process interface.



- Click “Process” button, system will start the image processing, user will get message at

status area. User can use the default value or change the value to get a custom optimized image.

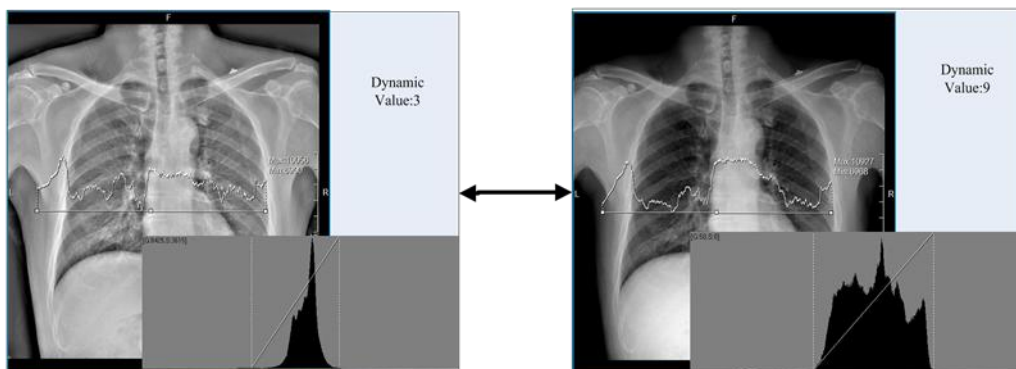
- Click “Undo” button, the image will back to the original image, and user can conduct the processing again.
- Click “Save” button, user can add or update the parameters of current optimization view and it needs admin user’s authority. User should change the name of optimization view then click this button in order to add a new optimization item, or just update the value of current optimization view.
- Click “OK” button, the processed image will be applied to replace the original image and back to the acquiring or preview interface.
- Click “Cancel” button, system will exit the image advanced process interface.

In order to get a high quality image, It is required that the advanced user should clear about the effects of the parameters.

Parameter description:

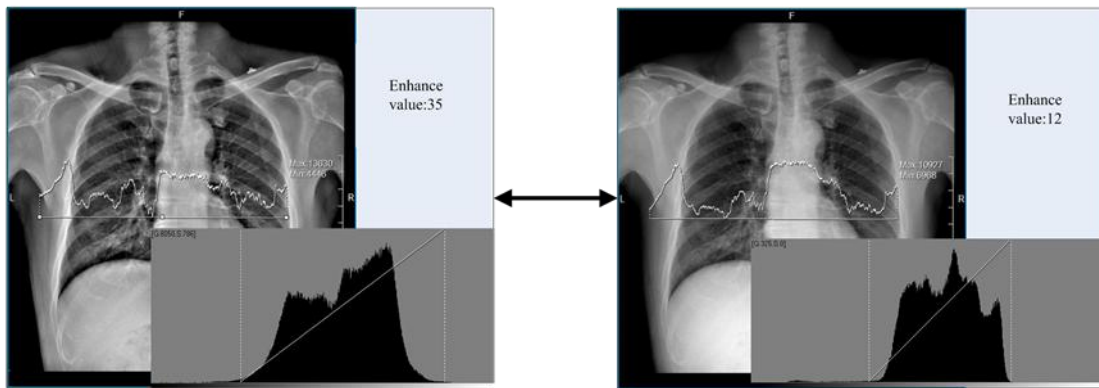
1. Dynamic: Dynamic range compression.

Use this parameter, user can dynamic adjust the gray scale of the image. Minimize the value means to display image in a relatively small range gray scale. Increase the value means to display image in a relatively large range gray scale.



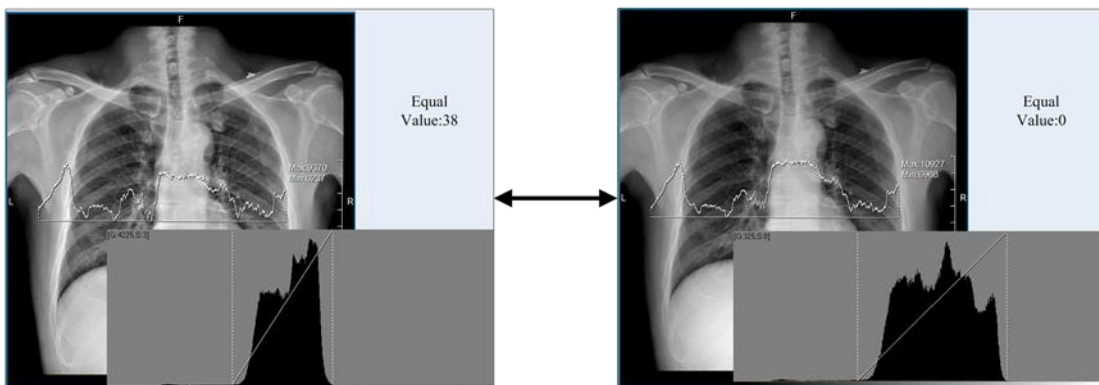
2. Enhance: Image enhancement.

Change the value of the “enhance”, user can get the image of different details. And user can see the details of whole image more clearly.



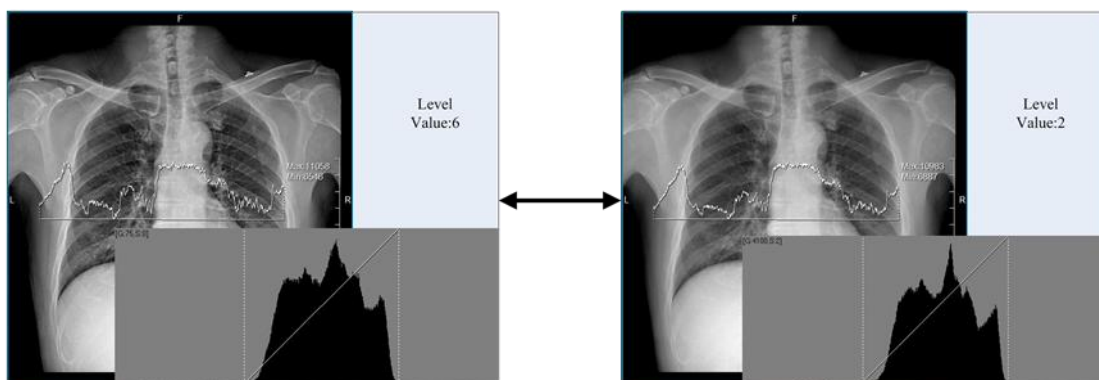
### 3. Equal: Image histogram equalization.

Through adjustment of this value, the intensities can be better distributed on the histogram. This allows for areas of lower local contrast to gain a higher contrast. Histogram equalization accomplishes this by effectively spreading out the most frequent intensity values. User should attention that there may be some noise on a histogrammed image, or some details of the original image will disappear.



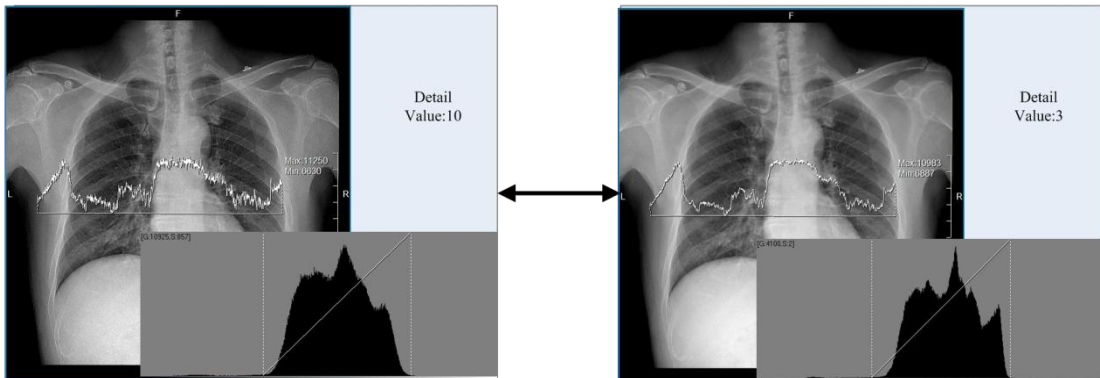
### 4. Level: Level of detail.

User can control the exactly detail level through the adjustment of this value. It's work with the value of detail.



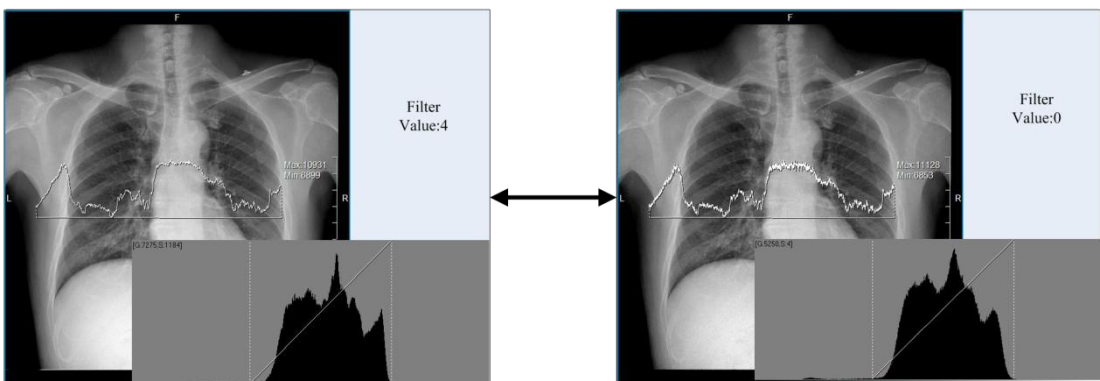
### 5. Detail: Detail enhancement.

Different with the enhance parameter, it works with the level of detail. Means user can set detail value to each level. The higher the level and detail value, the more strength of detail will be enhanced. In the same time, user should know that the enhancement of the detail will bring some additional noise to the image, and it has effects on the smooth of the image.



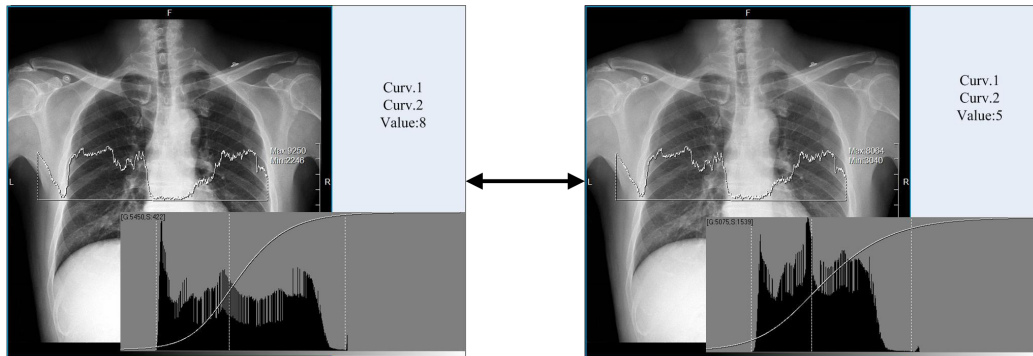
#### 6. Filter: Noise filter.

Used for removing noise from an image, after processing, the smooth of the image will be enhanced. It also cause relatively little blurring of edges and details.



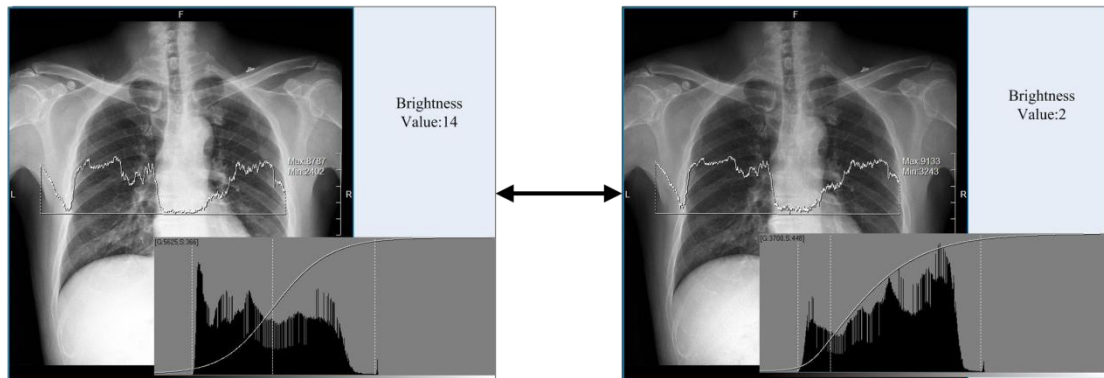
#### 7. Curv.1, Curv.2: Curvature of s-curve.

Work with the brightness parameter. The higher the s-curve value, the contrast of the brightness effective area will be more improved, and contrast of other area will be more decreased.



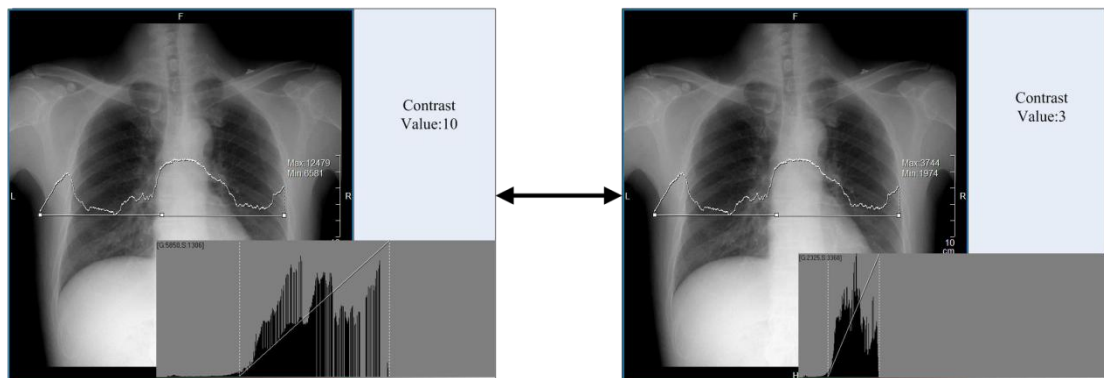
8. Bright: Image brightness.

Work with the curv.1 and curv.2 parameter. Mostly the higher the brightness, the contrast of the scale at lower gray value will be decreased, and the contrast of the scale at higher gray value will be improved; The lower the brightness, the contrast of the scale at lower gray value will be improved, and the contrast of the scale at higher gray value will be decreased.



9. Contrast: Image Contrast.

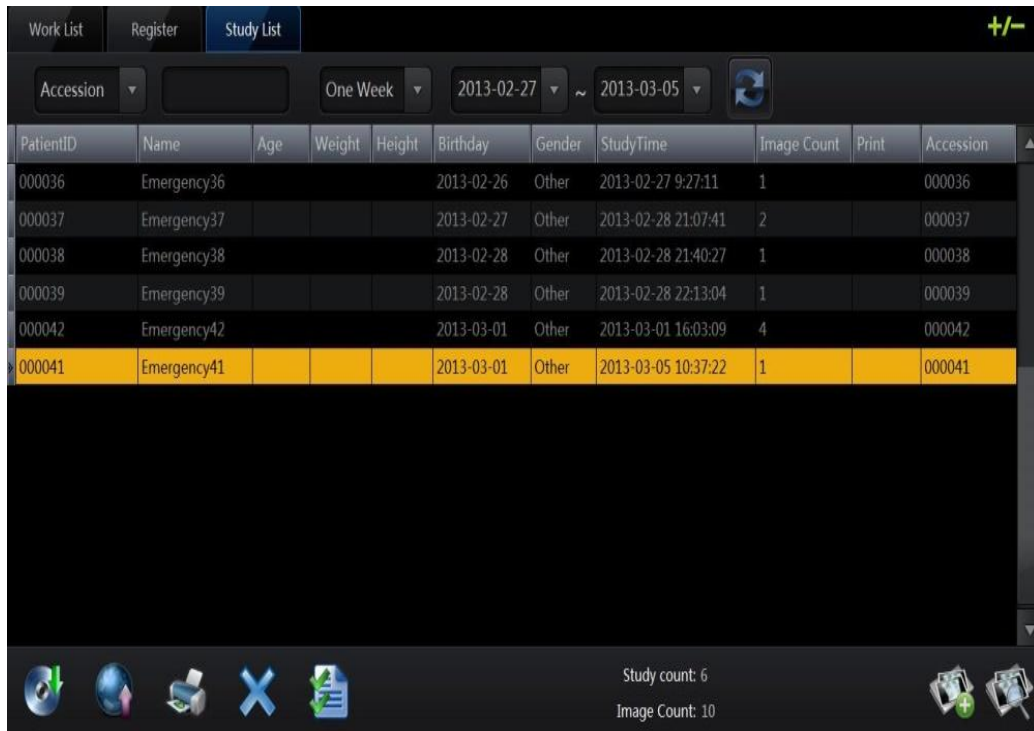
It has effects on the whole scale image. The higher the contrast, the gray value of image will spread on a relatively large scale; the lower the contrast, the gray value of image will spread on a relatively small scale. Effect images as Figure 4.11.





## Image Archive, Export and Printing

This chapter will concentrate on image archive, export and printing which used in the study list




PatientID	Name	Age	Weight	Height	Birthday	Gender	StudyTime	Image Count	Print	Accession
000036	Emergency36				2013-02-26	Other	2013-02-27 9:27:11	1		000036
000037	Emergency37				2013-02-27	Other	2013-02-28 21:07:41	2		000037
000038	Emergency38				2013-02-28	Other	2013-02-28 21:40:27	1		000038
000039	Emergency39				2013-02-28	Other	2013-02-28 22:13:04	1		000039
000042	Emergency42				2013-03-01	Other	2013-03-01 16:03:09	4		000042
000041	Emergency41				2013-03-01	Other	2013-03-05 10:37:22	1		000041

Study count: 6  
Image Count: 10

Study List

### Image archive

In archive process, the images will be sent to PACS server follow the DICOM 3.0 standard. Before the use of image archive, the parameters of DICOM storage must be properly configured (reference to chapter 6).

User can click button  “image archive” to execute the image archive process. But it is unnecessary if configured to archive automatically after end of a study.

If there is a failed message, then user should check the communication with the PACS.

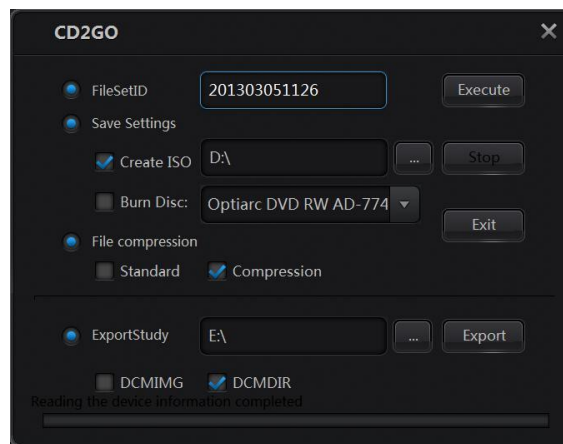
### Image export

The system provides two ways of export, and support customized export. User can export all or selected patient’s data from the study list.

### Burning CD



Click button “CD2GO”, following interface will be displayed:



### CD2GO

The system will generate a default file set id, and also user can edit it. User can select to create an ISO file or write the file to CD. If there is no disc driver, the burn disc item will be disabled. File compression provides 2 items: standard and compression which represent for “not compressed” and “compressed”. After configuration, click button “Execute”, system will generate the ISO file or burn the data to CD.

### Export to selected folder

Besides burning CD, user can also export patient’s data to a selected folder. First user should select a folder for item “ExportStudy”. And then there are two items:

- DCMIMGA: Export only DICOM images.

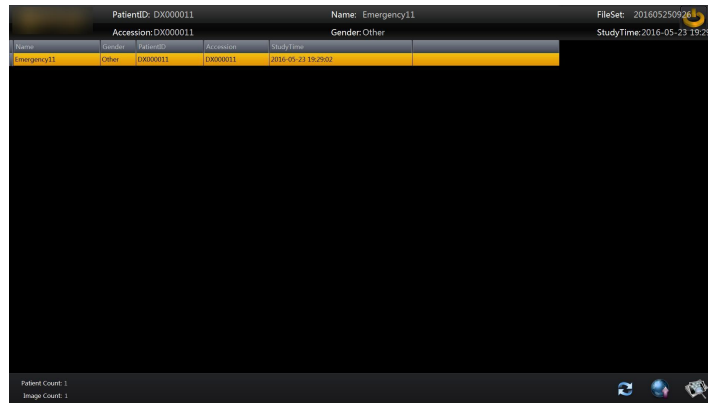
The export will create a fold named with patient name and accession. For example: Emergency41-000041. All DICOM image of current patient will save to the folder.

- DCMDIR: Export patient’s information, DICOM images with a viewer program.

Config	2013-03-05 11:55
DICOM	2013-03-05 11:55
Log	2013-03-05 11:56
logo	2013-03-05 11:55
AUTORUN.INF	2013-03-05 11:55
CDViewer.exe	2013-01-17 15:24
DICOMDIR	2013-03-05 11:55
MFC71.dll	2013-01-17 15:24
msvc71.dll	2013-01-17 15:24
msvcr71.dll	2013-01-17 15:24
View.dll	2013-01-17 15:24

### DCMDIR export

Running the CDViewer:



CDViewer

Double click the select patient or click preview , user can preview the image of current patient.



Image preview of CDViewer

The CDViewer also support to upload patient images to PACS server after configuration.

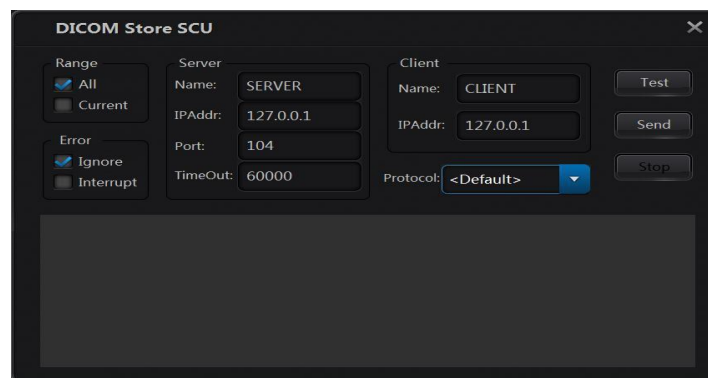
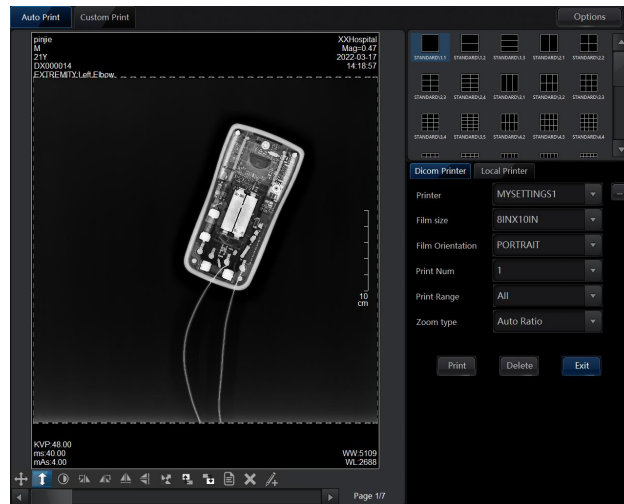


Image uploading of CDViewer

### Image Print


When accept the print operations, system will send images to printers that support DICOM print services protocols, and user can defined the parameters of these printers

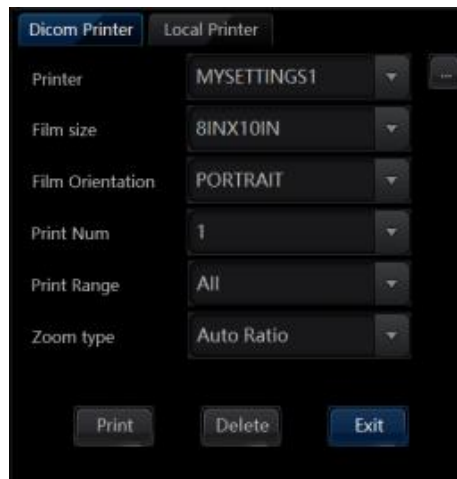
In the image preview interface, click button “Print”:



### Print Preview

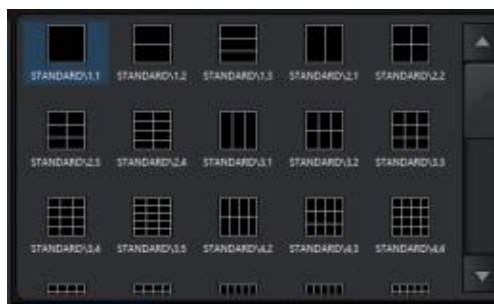
The preview interface provides several items:

Click the , user can configure the property of select printer. All the property is referenced to DICOM 3.0 standard.



### Configuration of printer

Choose layout of images:



### Layouts of images

Film size: the film size should consistent with the printer.

File orientation: “LANDSCAPE” for horizon, “PORTRAIT” for vertical.

Print Num: the copy of current image.

Print Range: Print all the pages or only current page.

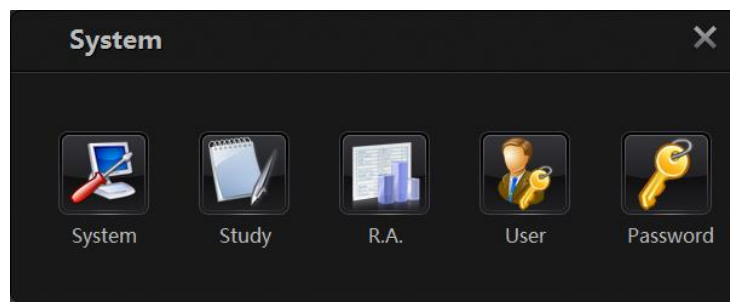
Zoom Type: Print at ratio of 1:1 or auto ratio.

## System Configuration

System provides five parts of management:

- System management
- Study management
- Quality Assessment
- User management
- Password management

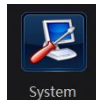
Different user may have different rights to conduct the operation.

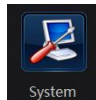


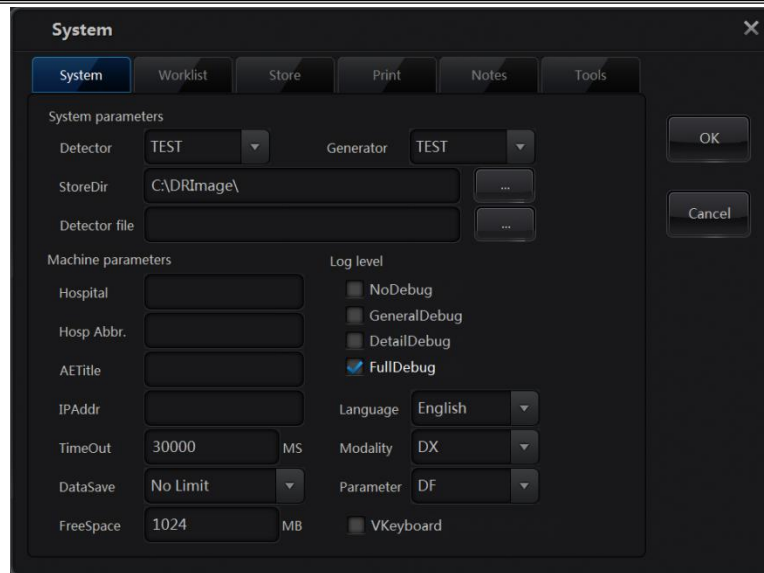
System configuration

## System Management

System configuration



Click button  to enter the system management interface.



### System management

- System parameters

Detector: Select type of detectors. The detector in the list means that the system supports these kinds of detector. User should select the right type for the detector.

Generator: select type of generator. If the communication with the generator is necessary, user should select the right type for the generator.

StoreDir: The storage folder of patients' images. It is required the folder should in a relatively large space drive, and make sure the system is able to access.

Detector file: Detector files for FUSSEN detector. (May unnecessary for other detectors)

- Local machine parameters

Hospital: name of current hospital.

Hosp Abbr: Flag of current hospital. (For example: SZ. Then the patient id will like SZ000041).

AETitle: the AETitle property in DICOM. Used as identification of local machine.

IP Addr: IP address of local machine.

Timeout: Timeout of network connection.

DataSave: the period of keep patients' image data in local storage.

**[Warning]** the data expired the date will be cleared. User should make sure that the data was uploaded to the storage or backup by other media.

FreeSpace: Warning if the space less then configured free space. User can find the flag in the

status bar of system: 

**[Warning]** if the status flag of free disk space turns to red, means the space of the disk will

soon running out, user should backup the data or add additional storage drive.

- Log level

There are four level of the log: Nodebug, GeneralDebug, DetailDebug and fullDebug. Normally Nodebug or GeneralDebug will be enough. DetailDebug and fullDebug are used only for tracing problems of the system, and in the same time it'll generate large size log files.

- Other Items

Language: select language of system.

Modality: type of current modality.

Parameter: type of image processing.

DF: Default

HC: High Contrast

HD: High Dosage

LD: Low Dosage

SF: Soft

Vkeyboard: change usage of the virtual keyboard.

## Worklist

The screenshot shows a 'System' dialog box with a 'Worklist' tab selected. The dialog contains the following configuration options:

- DICOM WORKLIST No.1**
- AETitle:** BUNNY (with a 'Clear' button)
- IPAddr:** 192.168.1.109
- Port:** 3000 (with a 'Test' button)
- Modality:** Ignore to validate modality type (dropdown menu)
- AETitle:** Ignore to validate AETitle (dropdown menu)
- Refresh:** Not refresh (dropdown menu)
- DataSource:** Worklist Only (dropdown menu)
- CharacterSet:** GB18030 (dropdown menu)
- BodyPart Map:**  (with a link icon)
- AccessionNumber:**
- StudyUID:**

Buttons for 'OK' and 'Cancel' are located on the right side of the dialog.

### Worklist configuration

System can load patients' data from RIS or registration station through the worklist. So the parameters must be property configured. More information about worklist can reference to the DICOM standard.

AETitle: DICOM AETitle of worklist server.

IPAddr: IP address of worklist server.

Port: Port of worklist server for connection.

Modality:

1. Ignore to validate the modality AETitle:

Accept all the worklist data no matter the modality type.

2. Exclude not DX data

Accept only DX worklist data.

AETitle:

1. Ignore to validate the modality AETitle

Accept all the worklist data no matter the AETitle.

2. Exclude not the modality data

Accept only the data from the AETitle.

Protocol:

(Reference Digital Imaging and Communications in Medicine)

Transfer Syntax UID (0002,0010):

Uncompressed:

Implicit VR Little Endian:

Default Transfer Syntax for DICOM

1.2.840.10008.1.2

2. Explicit VR Little Endian:

1.2.840.10008.1.2.1

3. Explicit VR Big Endian:

1.2.840.10008.1.2.2

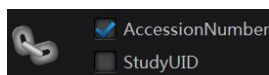
Lossless compressed:

4. JPEG Lossless

Refresh: the frequency of query worklist data.

CharacterSet: Using the defined character set to the worklist information.

BodyPart map: enable or disable of function of map the body part of PACS with local RIS code.

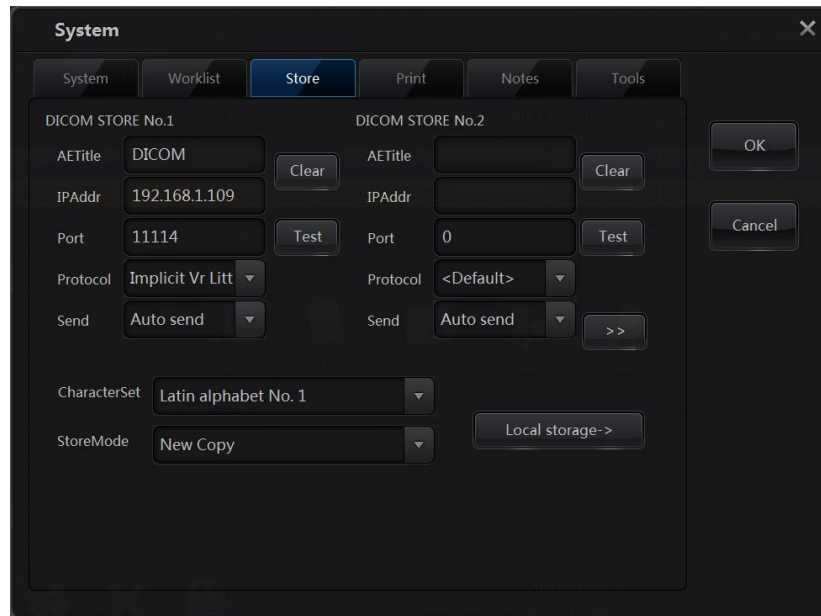


: Configure the identity of a study through the AccessionNumber or

StudyUID. Mostly, it depends on the PACS, so firstly user should know the way to identify a study.

## Storage

System supports two method of image storage: Net storage and local storage. The information of DICOM storage can reference to DICOM standard.



### Net storage

- Net storage:

CharacterSet: CharacterSet to encode files in dicom file.

System can support to connect to totally 4 PACS servers.

AETitle: AETitle of PACS server.

IPAddr: IP address of PACS server.

Port: Port of PACS server for connection.

Protocol: (reference to the “Protocol” in section 6.2)

Send: the mode of sending image, including auto send or send by user.

CharacterSet: define the characterSet used for generating the DCM file.

- StoreMode:

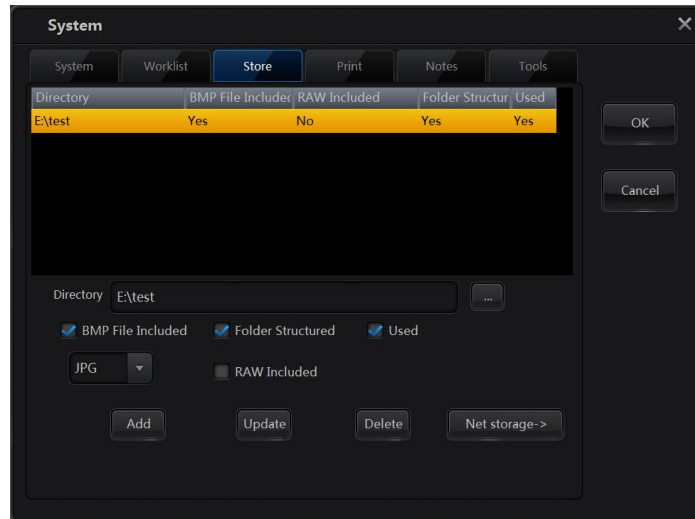
1. Update data: the PACS will overwrite the original image with modified one.

2. New copy: the PACS will never overwrite the original image; it will save a new copy of the modified one.



## Local Storage

Images can also save to local folders.



### Local Storage

Directory: local directory for the storage.

BMP File Included: To generate BMP files or not.

Image Type: export BMP or JPG images.

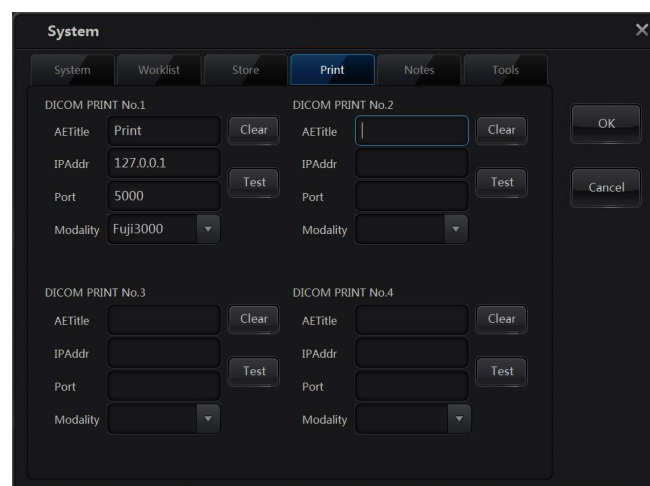
Folder Structured: Generate sub folder follow default rules.

RAW Included: export RAW files or not.

Used: Select current local storage or not.

## Print configuration

System will send image to printers when user conducts the print operation. Before the print, it should make sure the printers are correctly configured and connected successfully.



## Parameters of printers

System can support to send to totally 4 printers.

AETitle: AETitle of printer.

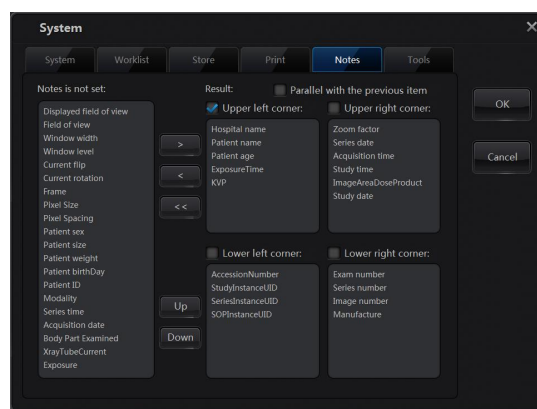
IPAddr: IP address of printer.

Port: Port of printer for connection.

Modality: type of printer.

### Notes

The notes determine which information shows in the corner of the image, it has effects on the image preview and printing. System defines 4 positions to display the information. User can select one position at one time to add or delete items.

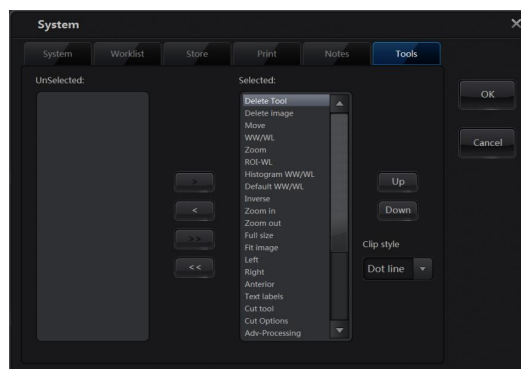


### Notes

Parallel with the previous item: current item will displayed in the same line previous item which connected with character “/”.

### Tools

The tools refer to buttons in the image preview interface. System supports to show or hide the tool buttons, and also change the order of them.



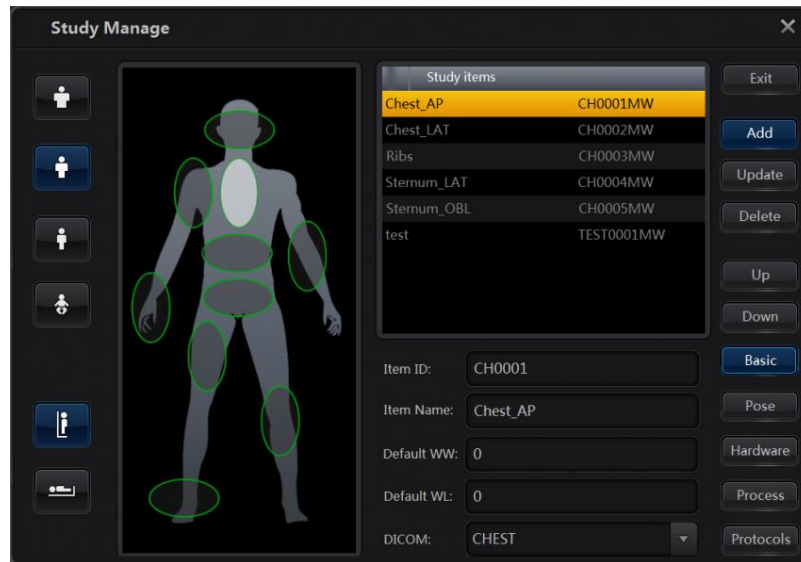
### Tools

Clip style: Set the style of background for clipping images.

## Study management

User can each of the items in the system as following steps:

1. Select the body size.
2. Set the wall or table
3. Select a body part.
4. Select a study item.



Study Management

- Basic information

Item ID: ID of the study item. It should be unique in the system.

Item Name: Name of the study item.

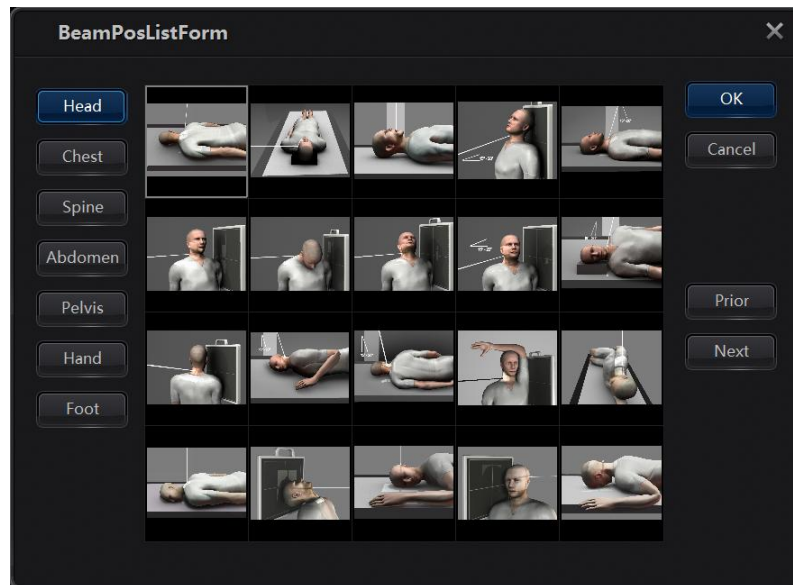
Default WW: default window of the study item. (It will automatically calculate if the value is 0)

Default WL: default level of the study item. (It will automatically calculate if the value is 0)

DICOM: Body part name defined in DICOM.

- Pose

Click button “select” to select a new body maker.



body Maker

- Hardware

Edit parameters of generator, including parameters that in AEC mode.

KV: the KV value of generator.

mA: the ma value of generator.

Time: exposure time of generator.

Film screen: Film screen of generator.

Density: Density of generator.

AEC: select the AEC field.

Synch: if checked the bodysize, above value will be set to item in different body size; if Auxiliary checked, then above value will be set to item in different aux.

- Process

Cut Mode: clip style. If auto clip is enabled, then the system will generate the clip box at relatively large, normal or relatively small mode.

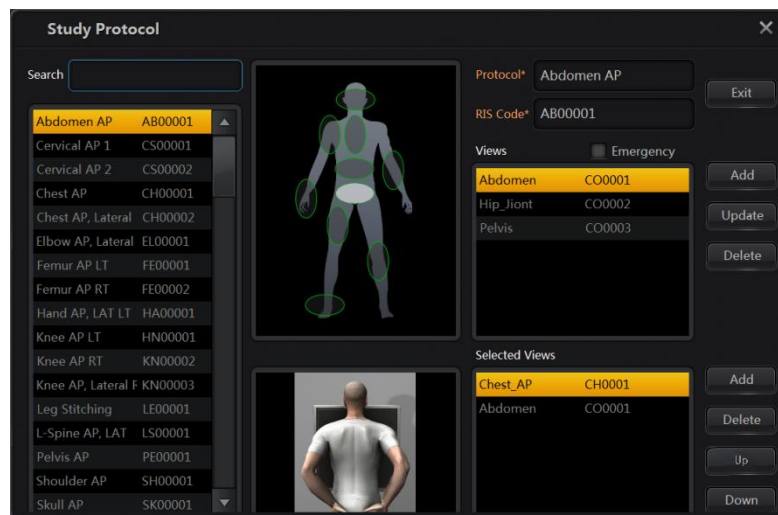
Rotate: set the value of rotate angle. The acquired image of current item will rotate the defined angle.

Flip: set flip style. The acquired image of current item will flip in defined style.

Optimize: Image process mode. Processing the acquired image of current item use defined optimization method.

- Protocol

User can add update or delete the protocols of study. The protocol can include one or more study item in the list.



### Protocol

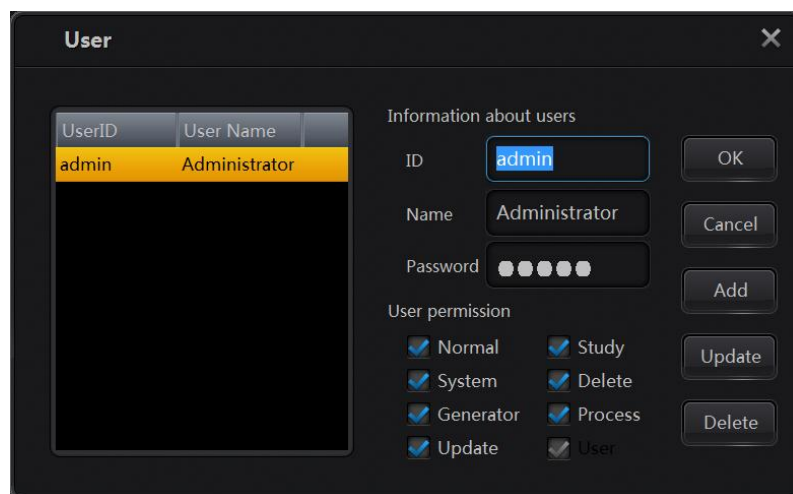
Protocol: Name of the protocol.

RIS Code: Code to commutation with RIS.

Emergency: Used as a default protocol of emergency patient or not.

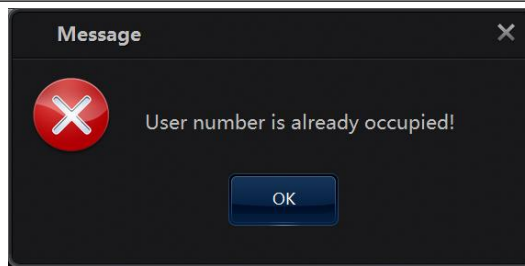
[Note] the emergency item is used only for emergency user. When user creates a new emergency study, it'll use the emergency protocol.

### User Management

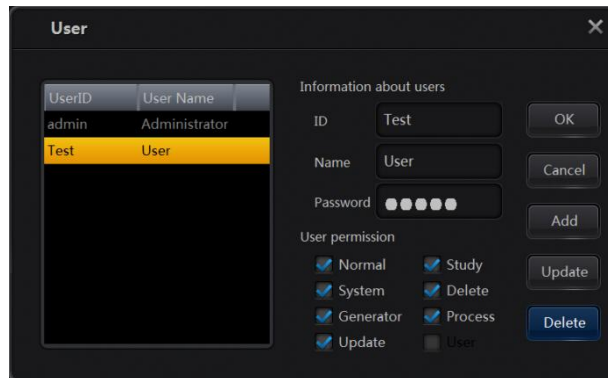


### User Management

- Create a new user. User id, name and initial password is necessary to input. User can also distribute authority. Click “Add” button, this user will be added to the system. If the user ID occupied, then there will be an error message, then user need to give up the “add” operation or update selected user’s information.



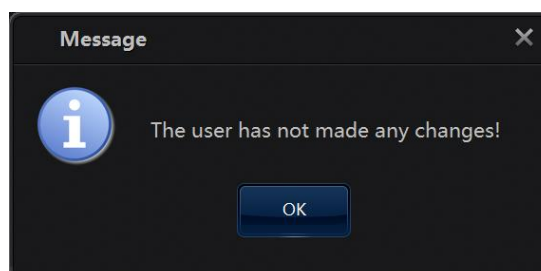
If the user is successfully added to the system, then the user list will display the user's information:



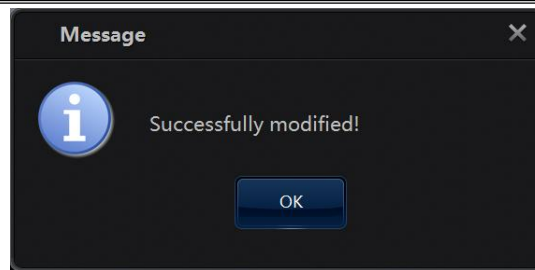
Authority description:

Name	Description
Normal	Conduct the normal study operation.
Study	Conduct the study manages operation.
System	Conduct the system configuration.
Delete	Delete record of the study.
Generator	Conduct the generator configuration. [reserved]
Process	Conduct the image adv-processing.
Update	Conduct the modification of study information.

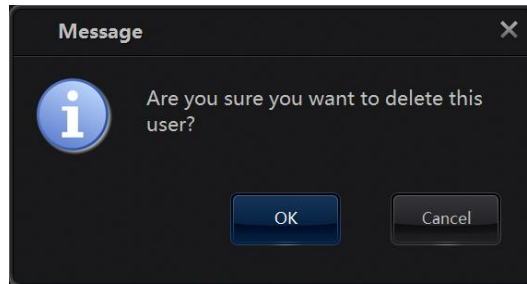
- Update users' information. Change user name, password and authority, then click "update" button. If there's no change, then will pop up the hint message:



If successfully modified, then will pop up the hint message:



- Delete the user. Click “Cancel” button to delete selected user.



If select “OK” to confirm the delete operation, then the user will be deleted.

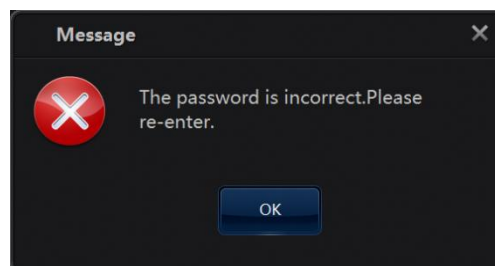
[Note] Only the admin user can modify users’ information and distribute authority to different user.

### Password modification

User can change the original password by input the original password, new password and confirm password.

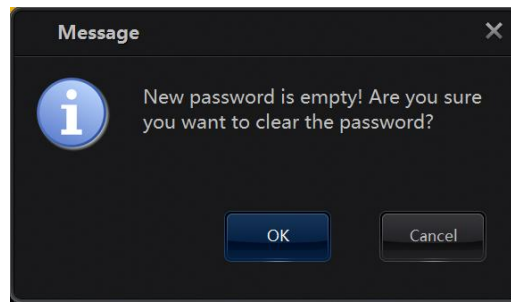
A dark-themed dialog box titled "Password" with a close button (X) in the top right corner. It contains three input fields: "Old Password", "New Password", and "Confirm". Below the input fields are two buttons: a blue "OK" button and a grey "Cancel" button.

If the original password is not correct, then there will be an error message:



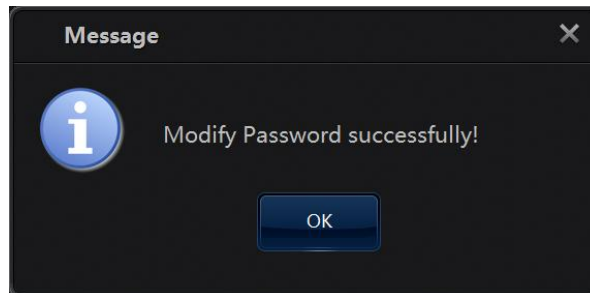
User should input the original password again. Then click “OK” button to conduct the modification.

If the new password was set to empty, there will be a hint message:




Click “OK” button, then password will be set to empty.

If the password was successfully modified, then there will be a message:



## Image stitching

User can enter the stitching interface by clicking “Image Stitching”  in the image preview interface. Before to enter the image stitching, please make sure the current study has at least two saved images.

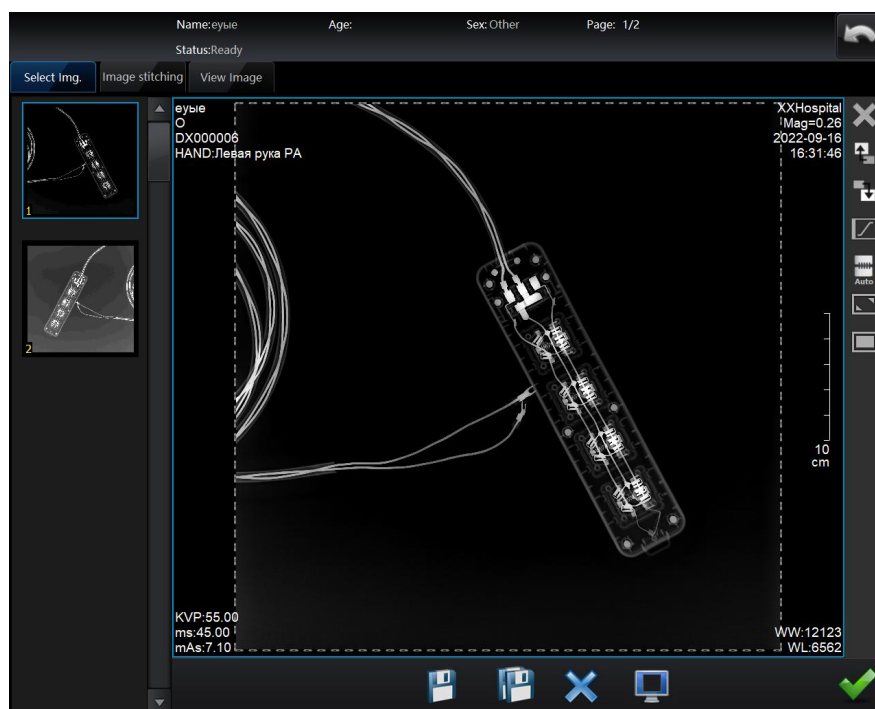


Image stitching





: Save current image. If user modified the image, and want to apply to the stitching, please conduct this operation.



: Save all images. If user modified the images, and want to apply to the stitching, please conduct this operation.



: Delete image for stitching. Used to select the image for stitching, use can delete other images that not used for stitching.




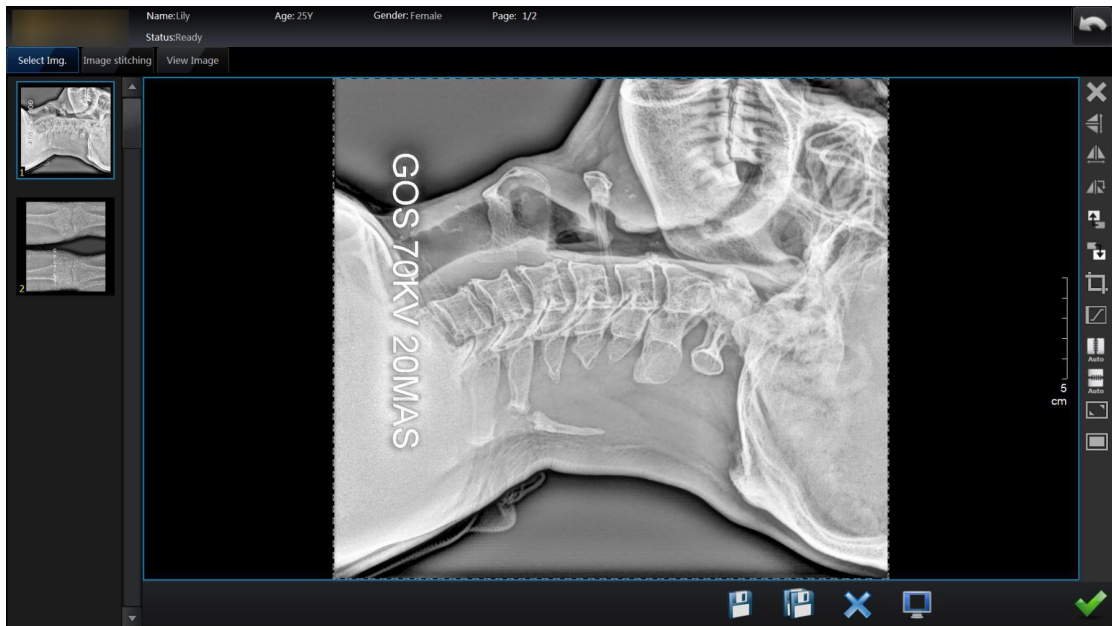
: Change the layout of the image.

Description about tool buttons:

Tool button	Description	Tool button	Description
	Flip V		Flip H
	Rotate 90		Histogram WW/WL
	Exchange with the next		Exchange with the prior
	Area select Tool		Delete Tool
	Start Stitching		Screen Size
	Full Size		



Click the button  to access the stitching screen, this screen consists of three function screen: Select Image, Image Stitching, View Image, as shown:



Before the image stitching operation, the user should ensure that all selected image must be acquired from stitching exposure .



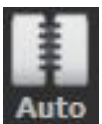
Delete: delete the current image.



Move back: click this button to move the current image up one step.




Move forward: click this button to move the current image down one step.

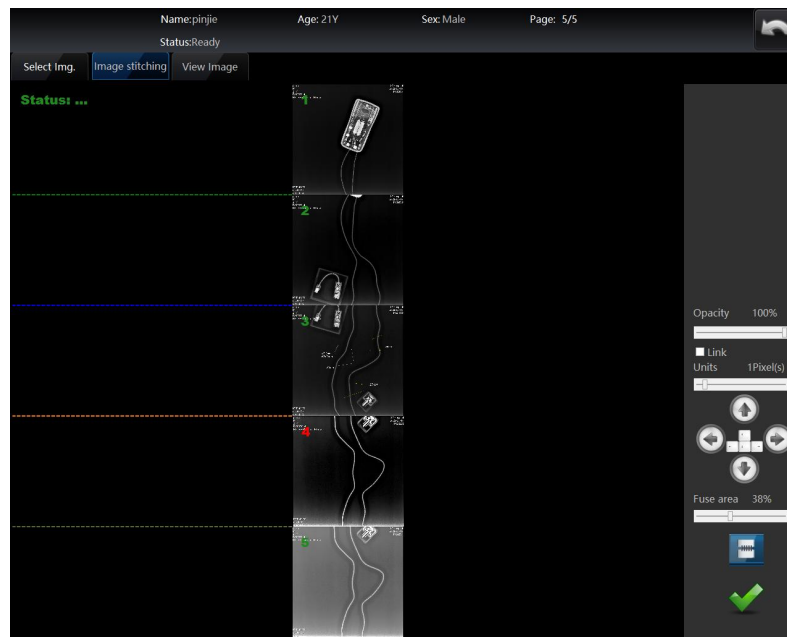


H-stitching: The system stitches the selected images in horizontal automatically.



V-stitching: The system stitches the selected images in vertical automatically.

After selecting the image, click  to enter Image Stitching screen. In this screen, the user can stitch images manually.



Opacity: Move the slider to adjust the opacity of the overlapping area.

Units: Move the slider to adjust the dixel(s) of the overlapping area.

Select one image, the number of this image changes to red.



Click the buttons or click the orientation key on the black board to adjust the position of the selected image.



Click the button to trim the selected image.



Fuse area: Move the slider to adjust the display degree of the overlapping area.



Click the button to save the setting parameters and enter the View Image screen.



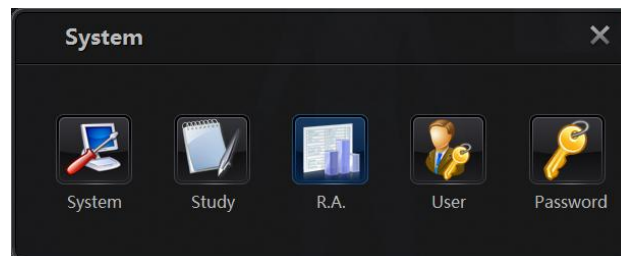
Click **Reject** to save the stitched image

Click **Accept** back to Stitching Image Screen.

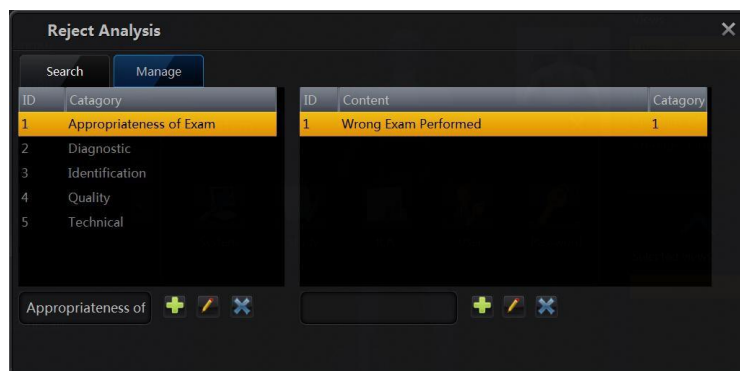
## Reject Analysis

### Settings

User should enter the reject analysis interface to edit the settings by click button “R.A.”.



Then enter the “Manage” page, user will be able to add, edit and delete the items of category and content of it.





: Click button to add a new item to the list of category and content. First use should input value in the input box, and the text should not in the list.



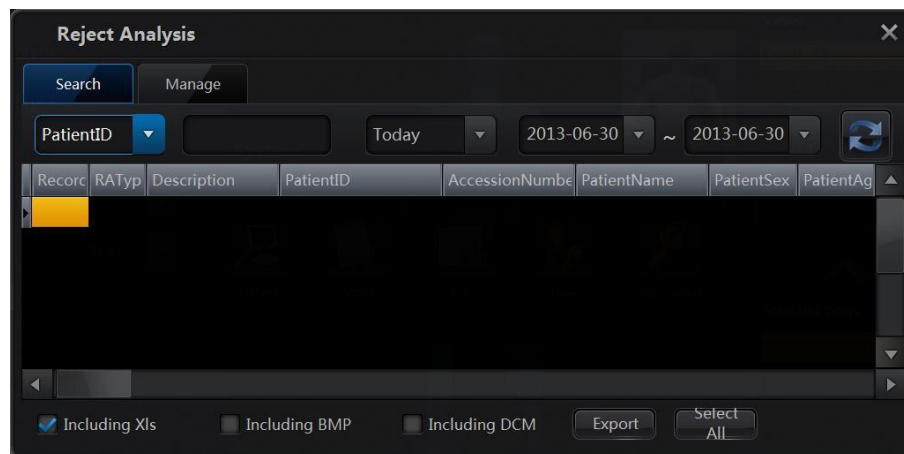
: Click button to update value of item in the list of category and content. First use should change value in the input box, and the text should not in the list.



: Click button to delete an item in the list of category and content. First use should select an item.

### Reject records analysis

Enter the “Search” page; user will be able to query the information by defined conditions and period of time.



Usually, user needs to export the records, and there are some options:

- Including Xls: Export the records to a .xls file.
- Including BMP: Export BMP image file if there's any images related to the record.
- Including DCM: Export DCM image file if there's any images related to the record.

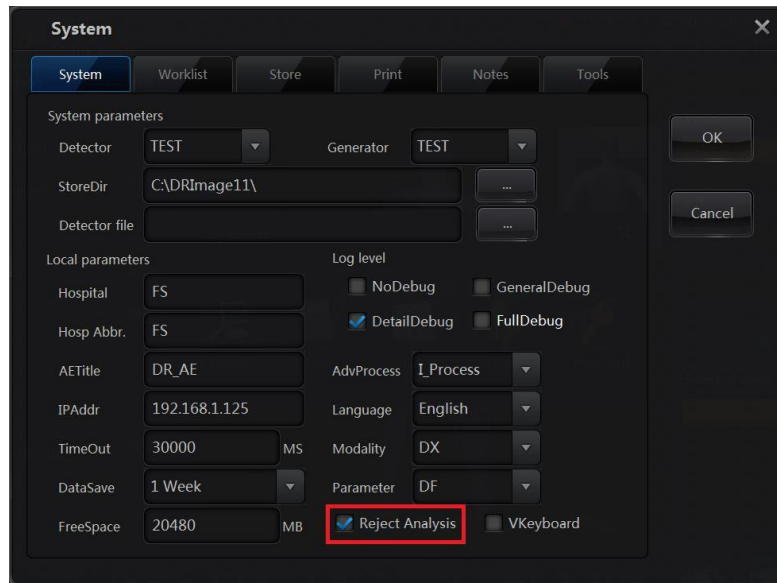
Click “Export” button, the system will start the export operation.

Click “Select All” button, all records in the list will be selected.

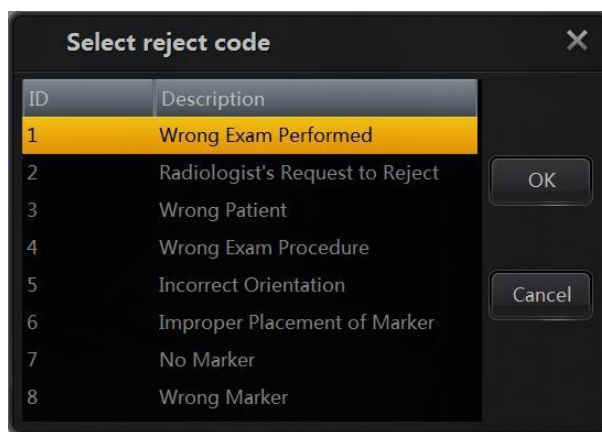
### Select reject code in the workflow

User should configure the options to enable or disable the reject analysis.

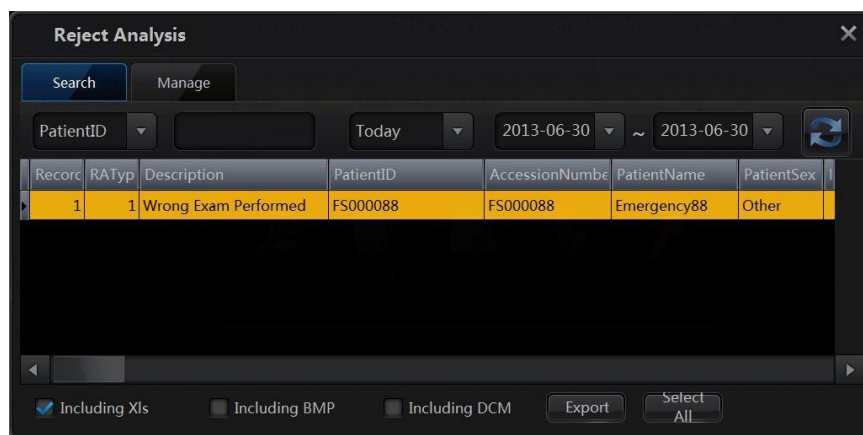
Checked the “Reject analysis” to enable the reject the function, or unchecked to disable it.



Once “Reject analysis” is enabled, it has effect on the Image invalidate, image delete and study delete operation, after user conduct the operation, and there will be a message:



User should select a reject code in the message box as figure 8.4, otherwise the operation will not continue. If reject code selected and clicked “OK” button, then will be a record add to the reject list.



## **6.2 Use of Equipment - Digital Radiography Mode**

### **6.2.1 Filter Line Device DR Radiography**

The X-ray tube of the radiography table is rotated to the horizontal 0 degrees, press the lamp button and the lamp of collimator is on and the size of the light field is adjusted by operate the knob on the collimator. Adjust the position of the tabletop and the X-ray tube by the corresponding buttons on the control box or the tabletop movement unlock footbrake to make the light align with the patient's radiography position. Select a examination in the image acquisition workstation, select appropriate radiography parameters, press the hand switch to make a radiography, and use the DR acquisition workstation to collect images.

### **6.2.2 Chest DR Radiography**

The person who need to be examined stands in the middle of vertical buck stand, and her/his chest close to the flat panel detector, and adjust the height of the flat panel detector according to the height of the person. The X-ray tube of the radiography table is rotated to 90 ° vertical position, by using the collimator light and the button of the control box to adjust the X-ray tube position, verify that the vertical line of the cross projected corresponds to the center of the flat panel detector. Select a examination in the DR acquisition workstation, select appropriate radiography parameters, press the hand switch to make a radiography, and use the DR acquisition workstation to collect images.

### **6.2.3 Initial RUN-UP**

The initial run-up of the equipment after it has first been installed, by the professional installation personnel in accordance with the adjustment description of the high voltage generator in the specification, until the initial run-up is completed.

## CHAPTER7 COMMON FAULTS AND TROUBLESHOOTING

### 7.1 Fault Code and Troubleshooting

#### 7.1.1. HV Generator

Table 7-1

Error code	Designation	Meaning
1	ERR_GENERATOR_PREPACTIVEINITIALIZE	The handbrake is ready to trigger during initialization
2	ERR_GENERATOR_XRAYENABLEINITIALIZE	The second hand brake is triggered during initialization
3	ERR_GENERATOR_DCBUSRELAYFAULT	The software is abnormally powered on.
4	ERR_HARDWARE_FIL_FAULT	The filament board is abnormal
5	ERR_HARDWARE_CURRENT_OVER	Resonant current feedback overlimit (hardware)
6	ERR_HARDWARE_KV_OVER	KV feedback overload (hardware)
7	ERR_HARDWARE_MA_OVER	MA feedback out of limit (hardware)
8	ERR_HARDWARE_TH_OVER	Nose temperature out of limit
9	ERR_HARDWARE_SLINK	Tankground missed
10	ERR_HARDWARE_INV_OVER	Inverter current overlimit (hardware)
11	ERR_GENERATOR_DCBUS_OVER	DCbuS voltage high
12	ERR_GENERATOR_DCBUS_LOW	DCbuS voltage low
13	ERR_MCB_POWER_ERR	The power supply of the board is abnormal
14	ERR_TIMEOUT_PSWITCH_RELEASE	The handbrake signal was not released for 30 seconds after the exposure
15	ERR_FIL_FD_OFFSET_OVER	The filament reference feedback is high
16	ERR_FIL_FD_OFFSET_LOW	The filament reference feedback is Low
17	ERR_TIMEOUT_PREP	Preparation timeout (12 seconds)



18	ERR_GENERATOR_TERMEXPMANUALLY	Abnormal termination of exposure, exposure is not out of KV
19	ERR_GENERATOR_CONSOLECOMMERROR	Console communication failure (Reserved)
20	ERR_FILAMENT_PARA_HIGH	The filament base is too high
21	ERR_FILAMENT_PARA_NOT_CLAIRATION	Bulb filament reference not corrected
22	ERR_GENERATOR_NOTSUPPORTEDEDMESSAGE	Communication message format not provided (warning)
23	ERR_GENERATOR_NOTALLOWEDMESSAGE	Current communication not allowed (Warning)
24	ERR_GENERATOR_NOTSUPPORTEDEXPMODE	Disallowed exposure mode (Warning)
25	ERR_GENERATOR_KV_LIMITT	KV setting not within permitted range (Warning)
26	ERR_GENERATOR_MA_LIMITT	MA Settings not in allowed range (Warning)
27	ERR_GENERATOR_MS_LIMITT	MS Settings not in allowed range (Warning)
28	ERR_GENERATOR_MAHIGHINEXP	ma feedback was 10% too high during exposure
29	ERR_GENERATOR_MALOWINEXP	ma feedback was 10% too low during exposure
30	ERR_DCBUS_VOLTAGEERROR	KV follow value loading error
31	ERR_ANODE_HEAT_OVER	The anodic heat capacity exceeds 80%
32	ERR_ROTOR_FAULT	Rotating anode anomaly
33	ERR_PERIPHERAL_DOORSWITCH	The door light signal is disconnected
34	ERR_RAD_PANEL_NO_RESPONSE	No response to radiography/fluoroscopy plate synchronization
35	ERR_RAD_SOFTWARE_DISENABLE	Wait for the software command to allow exposure timeout
36	ERR_PULSE_WITDH_OVER	The sequence dot - slice pulse is wider than 80% of the set frame rate period

37	ERR_PHVOK_CHECK_FAULT	Abnormal main loop
38	ERR_TUBE_TEMP_OVER	tube temperature switch off, temperature alarm

## CHAPTER8 MAINTENANCE

### 8.1 Maintenance by Operator

#### 1. General Rules

This equipment needs regular maintenance; following suggestions will be good for usage and safety.

- Keep room clean, dry, and with good ventilation.
- Mechanical safety will be degraded due to long time usage. In order to reduce potential damage to both user and patient, it is necessary to check mechanism if any loose and if brake is good.
- Correct electrical calibration can well perform machine's performance. Calibration work should be completed by professional staff authorized by our company.
- Machine should be in charged by designed person and establish file management system.
- Any changes to machine are forbidden to ensure both patient and operator's safety, if any changes needed, please contact with manufacturer.
- Adjustment for contact gap among moving parts with orbital bearing assembly should be done once a year.
- Regular big repair should be done, for details pls contact with manufacturer.
- If product has malfunction, contact with professional staff approved by manufacturer.
- Operator should be well trained and can complete normal inspection.

#### 2.Maintenance and Repair for unit

(1) Cleaning the surface of the unit, can use soft cloth with a little anhydrous alcohol to scrub.

Organic solution can't be used to scrub the surface of the machine parts absolutely.

(2) Anti-bacterial requested machine surface touched by patients, such as sterilizing the table panels, can use the ethanol for disinfection, but mercurochrome, iodine is not allowed. It is suggested that Ultraviolet radiation etc. is configured on a regular disinfection in the machine room.



**WARNING**

*For the disinfection work, unit power must be shut down! And disinfection liquid should be paid attention that it can't flow into the unit interior, lest the phenomenon of leakage and short circuit is occurred, which will lead to all kinds of malfunction, even cause injuries.*

#### 3.Maintenance and Repair for collimator

- (1) Collimator should be kept clean, dry, transmission parts and components shall not have dust.
- (2) After period of time usage, check whether the bar lead-leaf get loose, and fix it in time (check it every three to six months). Few thin lubricants can be added on internal mechanical parts.
- (3) When any malfunction is happened, it should be done by professional person or contact factory in time for maintenance.

#### 4.Maintenance and repair for X-ray tube assembly

- (1) After continuous exposure, it should pay attention to X-ray tube temperature lift. When the temperature of outer surface components exceeds 75°C, X-ray generator must stop loading automatically.
- (2) It should ensure that high-voltage cable plugs, sockets have good contact so X-ray tube filament is always on, and it can avoid X-ray tube to withstand cold high-voltage, thus extended x-ray tube life.
- (3) When X-ray tube components are used for the first time or idled for a longer time, it must be progressive loading before X-ray tube used, and do the sophisticated test to avoid damaging to the X-ray tube by instantaneous load.

#### 5.Maintenance and repair for high-voltage generator

- (1) It should ensure that high-voltage cable plugs, sockets have good contact so X-ray tube filament is always on, and it can avoid X-ray tube to withstand cold high-voltage, thus extended x-ray tube life.
- (2) After removal of high voltage cable sockets, it should pay attention to the residual charge, do not touch electrode by hand to avoid electric shocks. If needed, discharge it first.

**CAUTION**

*Attention: Clean dust on top of high-voltage generator.*

#### 6.Maintenance and repair for tables

- (1) All surfaces of Radiography bed table should be kept clean, dry, and variety of residues can be scrubbed with a soft cloth dipped with few absolute alcohol
- (2) Regular check if bearing or movement orbit is short of oil. After cleaning, it should coat with lubricant (grease) in time.

- 
- (3) No flammable liquids, gases near the equipment to prevent explosion.
  - (4) Protect grounding facilities, and inspections should be done every half year.
  - (5) Radiography table's sterilization methods are same as the unit's.

## 8.2 Maintenance by the Autholiftd Technician

PLD6500A Medical Diagnostic X-ray System is sophisticated, valuable medical diagnostic equipment. It is necessary that user's knowledge about machine's technical performance, structure principle, operating procedure and daily maintenance to give full play to the efficiency of the machine, prolong the useful life of the machine, ensure the normal use of equipment, and ensure the safety of operators and personnel inspected.

- 1、 Properly operating in the process of using X-ray machine, make its normal operation, and what's more important is that it should pay special attention to the body of X-ray protection, make X-ray operator and the patient's damage down to a minimum. For example, machine room should have protective equipment and measures (e.g., lead plate), the operator must use protective appliances (such as lead glasses) and wear protective clothing (lead cap lead, lead aprons, gloves), operator should be occupied area in effective operation when the patients with radiation inspection.
- 2、 This machine should be placed in air circulation, clean and dry work condition. It cannot be placed in the humidity, heat and sunlight exposure area.
- 3、 Control cabinet should be opened front and back cover regularly (depending on the environment, such as the six months to one year), and removed internal dust. For damaged parts, purchase the same model of spare parts from factory for replacement. During examination, pay attention whether there are any loose terminals and displacement phenomena, and fasten them.
- 4、 In area where the power supply and voltage has a high fluctuation, always pay attention to whether power supply and voltage is in permitted range. If it has high, low, mutation and other anomalies, machine should be closed immediately and check out the problem, it can only be used after problem solved.
- 5、 Do not press heavily on all buttons of controller to avoid dislocation, injury or poor contact, even damaged.

- 6、 Check frequently protective earth of each components is in good condition (grounding resistance is very small).
- 7、 Check power supply on a regular basis, and check power supply resistance value (or the power supply voltage value is changed), to make sure it meet machine's requirement.
- 8、 After using the controller, it should be cut off the power in time.
- 9、 Avoid striking of x-ray tube components during operation.
- 10、 When X-ray tube components are used for the first time or idled for a longer time, it must be progressive loading before X-ray tube used, and do the sophisticated test to avoid damaging to the X-ray tube by instantaneous load.
- 11、 When machine works continuously, please pay attention to the X-ray tube assembly to allow Thermal capacity, or check surface temperature of X-ray tube assembly , it can't exceed 75 °C.



***The personnel for the above inspection, maintenance and processing must be accredited by professionals; It's not allowed for other people to carry out such inspection, maintenance and processing.***

### 8.3 The Cycle of Maintenance and Repair

Time Interval	Contents of Maintenance and inspection
Daily Inspection	<p>Check if the signal, display and indicator are normal.</p> <p>Check if warning and danger SYMBOLS are good.</p> <p>Check if X-ray generator assembly has abnormal noise during exposure.</p> <p>Check if all grounding is good.</p> <p>Check if there is any loose, stuck on the button of the Console.</p>

Weekly Inspection	<p>Check if any oil leakage of the X-ray generator component.</p> <p>Check flexibility of table and column bearing, observe if any friction is too large, and coat bearing orbit with lubricating oil.</p> <p>Check if any loose and shedding of fastener parts between components, if any, should be fixed them in time.</p>
Check every six months	<p>Check machine grounding resistance (less than <math>0.2\Omega</math>).</p> <p>Check if any filler come out of head of the HV cable because of heating.</p> <p>Clear silicone oil on high-voltage outlet, scrub High voltage plugs and sockets with ether or carbon tetrachloride, and then smear some new silicone grease, tighten the fixing ring of plug.</p> <p>Check the center of X-ray generator assembly and collimator.</p>

## **CHAPTER9 ATTACHMENT**

Appendixes attached with following circuits:

- a. Medical Diagnostic X-ray System JX