





Hazard Messages

In this manual, the following safety symbols are always used. Prior to the operation of this equipment, users should be familiar with these symbols and their meaning.

 **Danger:** Indicates an imminently hazardous situation which, if not avoided, will result death or serious injury. This signal word is to be limited to the most extreme situations.

 **Warning:** Indicates a potentially hazardous situation which, if not avoided, could result death or serious injury.















 **Caution:** Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

 **Note:** Indicates information or a company policy that relates directly or indirectly to the safety of personnel or protection of property. This signal word is associated directly with a hazard or hazardous situation.

Safety classification of the equipment

- Protection against electric-shock:
Class I Equipment- type B application
- Extent of protection against harmful water: General equipment
- Degree of Safety in the presence of Flammable Anesthetics Mixture with air or with oxygen or with nitrous oxide: Not suitable for use in the presence of Flammable Anesthetics Mixture with air or with oxygen or with nitrous oxide.
- Working system: continuous operation with intermittent load

Safety symbols

Symbol	Description
	Alternating current.
	AC power.
	Dangerous voltage.
	Ionizing radiation.
	Type B equipment.
	Ground.
	Large focus.
	Small focus.
	Attention, consult accompanying documents.
	X-ray radiate.
	Power On.
	Power Off.
	Emergency Switch.
	This symbol indicates that the waste of electrical and electronic equipment must not be disposed as unsorted municipal waste and must be collected separately. Please contact an authorized representative of the manufacturer or an authorized waste management company for information concerning the decommissioning of your equipment.

Limited condition for transportation and storage:

1. Environment temperature: -20~+45°C
2. Relative humidity range: 10~80% no condensation
3. Range of atmospheric pressure : 700~1060hPa
4. Conforming to the standard YY91099-2007

Please contact your supplier or the manufacturer for repairs and maintenance if there is any trouble of machine.

Manufacturer: Shenzhen Landwind Industry Co.,Ltd.

Address: 4F,Block E, Bijing Bldg.81, jingtian Road, Futian District, Shenzhen China

Call center: 400-700-3788

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Chapter I General

1.1 Installation environment conditions:

1. Environment temperature: 10~+30°C
2. Relative humidity range: 45~75% no condensation
3. Range of atmospheric pressure : 860~1060hPa

1.2 Space requirements

- Checking room area: 4.2×3.8 m² Standard;
- Operation room area: 4.2×2.0 m² Standard;
- Height of room: ≥3.0m;
- Height of the door: ≥2.3m;
- Width of the door: ≥1.4m;
- The brick wall of the examination room should has a thickness of 370mm (equate with 2mm Al), the thickness of the concrete wall should be more than 200mm;
- The lead glass thickness between examination room and operating room should be more than 1.5mm lead equivalent, and field of vision should not less than 0.25 m², with height of 1200mm from ground;
- Roof is 1.0mm lead equivalent.
- If the room is at the bottom of building, protection measure for the ceiling is needed; the protection should not less than 2mm Al equivalent. If the room is not at the bottom, there is not only the ceiling but ground is needed X-ray protection, which also requires 2mmAl equivalent. While the room is at top, it just needed to make a protection for ground.

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- If the room is at the bottom (either cottage or building), the glass of the examination room should use lead glass with 1mmAl equivalent or 240mm brick wall;
- It is advised that the room should have a smooth cement floor or ceramic tiles on the ground, if it is a wood floor, the installed location on the ground must be reinforced, and the ground under the installation of the base location demand of 100mm deep cement, and no less than 800 kg / m² bearing.

1.3 Power requirements

- 1) Three-phase AC380V, 100A power switch, independent earthing line and N line.
 - Voltage fluctuant range: ≤10%;
 - Power: ≥50kW;
 - Inherent impedance: ≤0.3 Ω ;
 - Earthing impedance: ≤4.0 Ω ;
 - Power line diameter ≥25mm²;
- 2) It is recommended that the user should configure with a 80 kW Regulator if the power supply is instability.
- 3) The hospital should be purchased a five-core copper cable with 3 × 25 mm² + 2 × 16 mm², which about 8.5M long.
- 4) The power of the device is large, please make sure the local transformer power and density of use of the equipment before installation.
- 5) It is required that there must be a hole for line between operating room and examination room. If the hole is on the ground, it must cover by 2mm Al.
- 6) Installation work should be carried out in accordance with related rules of power supply department.

Chapter II composition of the product and parameters

2.1 Product composition structure

Medical X-ray Equipment is mainly composed of high-frequency high-voltage generating device, tube, collimator, Radiography table and Radiography table control system. Different configurations and performances are provided according to customer demands.

Mechanical parts of this equipment are composed of Column and Radiography table. Integrated design of column and bed body is used in this Equipment, where the bed body is fixed to the ground via screws, and the column is fixed onto the bed body via screws, with horizontal and longitudinal movement of column along guide rails by using gear bearings. X-ray tube components and Collimator are vertically mounted on horizontal shaft of the column right above the bed body, capable for vertical movement and rotation; film box is mounted below bed panel, capable for horizontal and longitudinal movement along guide rails.

Mainframe system consists of high-voltage generator, control console, and X-ray tube.

2.1.1 Radiography table control system

Radiography table control system controls the longitudinal movement of the column, vertical movement of X-ray source movement, as well as the components radiography table horizontal movement by the circuit composed of power supply components, integrated control panel, control panel, as well as sensors, electromagnet brake components, etc.

Please refer to the Radiography Table for more information.

2.1.2 High-Frequency and High-Voltage mainframe system

The system contains high-voltage generator, control console and mainly provide X-ray tube with working voltage.

1. Console

Equipped with touchless membrane key and key tone, the console is connected with generator and other X-ray system.

2. Mainframe

Including high pressure oil tank, HF inverter, medium speed anode rotation controller

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(standard configuration), real-time controller and adaptor.

2.2 Main properties and technical parameters

⚠ Note: According to customer requirements and configurations, the equipment may have different performances and main technical parameters, as per the actual configuration:

Radiography table	bed movement range	Longitudinal	≥950mm
		Transverse	≥220mm
	Size of tabletop		2100mm×760mm
	Height		700 mm
	Movement of column and Bucky diaphragm		synchronously and manually move
	Film size		5"×7" - 14"×17"
	X-ray tube assembly vertical movement range		1100mm
	X-ray tube assembly longitudinal movement range		1350mm
	Rotation of column		±180°
	X-ray tube rotates around x ray tube support frame center		±90°
Generator	Power supply	Voltage	380V AC
		Frequency	50Hz
	Radiography	Nominal output power	50kW
		Tube voltage adjustment range	40kV - 150kV
		Tube current adjustment range	32mA - 630mA
Load time adjustment range	0.003s - 6s		
Grid	Size	15"×18"	
	Grid ratio	10:1	
	Line density	103	
	Focal distance	100cm/180cm	
Tube	Maximum Anode heat units	150kHU	
	Tube Voltage	150kV	
	Maximum power of tube	19kW/50kW	

	Target material	tungsten rhenium molybdenum (RTM)
	Target angle	12°
	Focal	0.6/1.2mm
	Anode rotating speed (50Hz)	2800 rpm /min
Collimator	Inherent filtration	Minimum 1.2mm AL. Equivalent
	Lamp timer	30s
	Operation mode	Manual

Chapter III Working principle

3.1 Block diagram of circuit principle

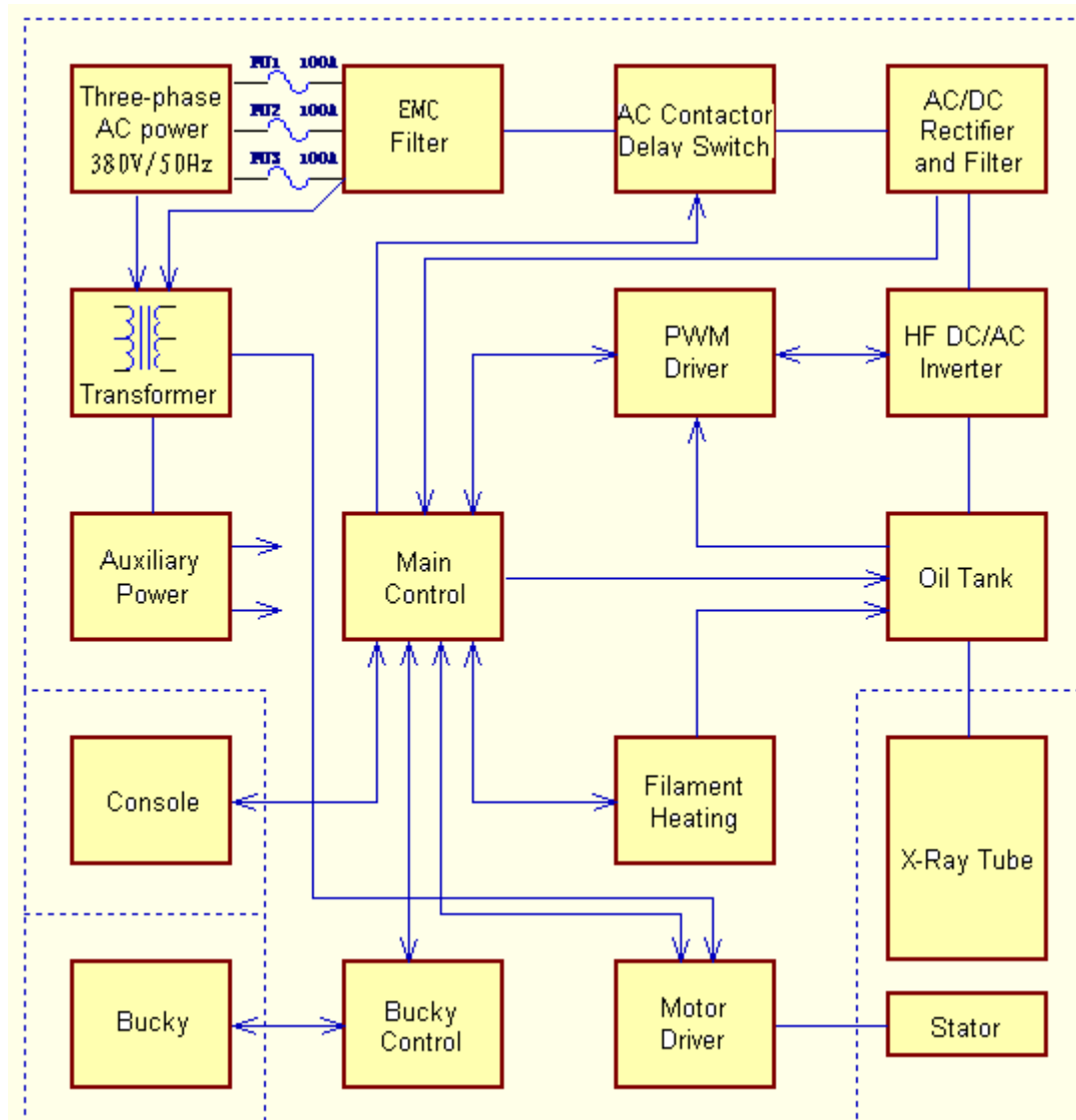


Figure 3-1 Block diagram of circuit principle

3.2 Principle of power and switch

Three-phase 380V power connects to the mainframe via L1, L2, L3 and N of wiring terminal X1, and is supplied to the inverter passing through fuse, filter, AC contact, rectifier module and filter unit. Another line of L3 phase feeds to power transformer supplying power

to the auxiliary power supply, which outputs +12V and -12V power to console and mainframe and auxiliary power to the driving circuit for filament heating. After energization, the system is shutdown. When "On" key on the console is pressed, the console send start orders to the mainframe which then changes connector unit terminal X3-8 (power control terminal) to high level after receipt of the order, the soft charging pulls in the AC contact K2, voltages from L1, L2, L3 phases perform soft charging to filter unit capacitor through soft charging resistance R1, R2 R3 and rectifier module. The charging voltage is monitored and detected by connector unit X4-1 (cold terminal) and X4-2 (hot terminal), when the voltage exceeds 420Vdc, main AC contact K1 is pulled in, voltages from L1, L2 and L3 is sent to the inverter through main AC contact K1, rectifier module V1 and filter unit, and then the main power supply circuit is energized. The machine is ready for start, X3-7 (power status terminal) is at high level, the mainframe control unit sends normal start signal to the console after receipt of ready-for-start signal, the whole machine is standby.

3.3 Generation and control principle

After startup, three-phase AC 380V power is loaded on inverter after rectifying and wave-filtering; when the console sends exposure order to the mainframe, the inverter acts, HF square wave output is loaded on high voltage oil tank to generate high DC voltage. Voltage sampling circuit of high voltage oil tank feedbacks sampling signals to pulse width modulation unit, which generates real-control pulse width modulation signal to regulate high voltage and consequently stabilizes high DC voltage.

Terminal "+kV FB" of generator oil tank top cover is feedback terminal of positive high voltage, which outputs 1V equal to 10kV output at high voltage terminal; "-kV FB" is feedback terminal of negative high voltage, which outputs -1V equal to -10kV output at high voltage terminal.

3.4 X-ray tube filament heating principle

Generator heats the filament through pulse width modulation AC voltage. Under different kV and mA combinations, the control procedure sends control signal of filament data

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through digital analog converting circuit, this signal controls filament heating inverter to generate pulse width modulation AC voltage on filament heating inverter. This HF voltage excite heating of filament.

 **Note: Filament is in pre-heating status during standby status.**

3.5 Start up and protection principles of rotary anode

When the position 1 of hand brake switch is pressed, rotary anode starter terminal X5-4 on 21001E panel is at low level, controlled silicon V76 is energized; rotary anode winding is energized to start. After 1 S latency, V75 stops, V77 is energized, at this moment, start-up voltage of rotary anode winding drops from 160V to 40V for normal operation, triode V53 is energized, status terminal X 5-3 is at low level, indicator lamp on the console illuminates and radiography preparation is completed. When the position 2 of hand brake is pressed and after radiography, V77 disconnects, and V78 is energized, 80V pulse DC current is loaded on anode winding till the anode stops rotation (about 10 s). If some faults impair start up and rotation of rotary anode, the triode V53 stops, V5-3 is at high level, the console displays fault information code E40 for anode start up fault. In this case, radiography may not performed even after position 2 of hand brake switch is pressed, and by this way the protection is achieve.

3.6 kV, mA and s interlock protection principle of capacity constraint

kV, mA and s interlock protection principle of capacity constraint is controlled by micro-computer control system intelligent module according to tube capacity characteristics calculation.

3.7 Control principle of radiography duration

Control circuit of radiography duration is digital circuit with double time limit function.

3.8 Control principle of common radiography

When the console is in radiography status, parameters, such as kV, mA, s/mAs values and Bucky diaphragm are selectable on the console according to radiation condition.

When the position 1 of hand brake is pressed, CPU of main control unit sends the order after detecting the information, and then the filament heating circuit of 21003C panel rapidly heat the cathode filament of the X-ray tube, rotary anode driver of 21001E panel starts up the rotary anode of X-ray tube for operation. When the position 2 of the hand brake switch is pressed, pulse width modulation circuit of 21003C panel generates pulse width modulation signal to drive the inverter, which then drives the high voltage oil tank to generate high voltage which is loaded on the X-ray tube to generate X-ray and to perform radiography. If the hand brake switch is loosed during radiation, the exposure radiography will immediately stop.

3.9 Control principle of Bucky diaphragm radiography

a) Bucky diaphragm is vibration type: Table or vertical chest radiography stand Bucky diaphragm is selectable on the console, when the position 1 of the hand brake switch is pressed, the rotary anode starts up to heat the filament, and when the position 2 of the hand brake switch is pressed, control relays of 2100 panel Bucky diaphragm and chest radiography stand Bucky diaphragm are pulled in, the Bucky diaphragm pickup winding is energized and starts to work, the pickup grid moves back and forth, after 0.5s latency, the control relay of table Bucky diaphragm or the control relay of chest radiography stand Bucky diaphragm disconnects, the radiography exposure begins, after pre-setting exposure time, the hand brake switch shall be loosed to reset the control circuit to the status as before.

b) The Bucky diaphragm is power type: table or vertical chest radiography stand Bucky diaphragm are selectable on the console, when the position 1 of hand brake switch is pressed, control relay of 21001 E panel table Bucky diaphragm or the control relay of chest radiography stand Bucky diaphragm pulled in, the Bucky diaphragm motor is energized and starts to work, the grid is driven and moves back and forth, when the position 2 of hand brake switch is pressed, radiography exposure begins, after presetting exposure time, the control relay of table Bucky diaphragm or the control relay of the chest

radiography stand Bucky diaphragm disconnects.

3.10 Fault detection principle

Mainframe control system performs self-inspection during electrification and performs monitoring to all units during operation of the mainframe, in case of abnormal condition, the system may suspend in real-time, send fault information to the console and send fault alert signal.

When the grid has phase voltage lower than 342Vac or loses phase, connector unit terminal X2-3" P-S is at low level, the control system may generate power fault information code "E00" after detecting this low level, the mainframe cut off main power supply.

When the position 1 of hand brake switch is pressed, the control system will monitor filament heating circuit and anode driving circuit. The filament is heated and temperature will be increased, if the heating current is over-low or the heating voltage is over-high, the control system will generate default information of filament unit as "E03". X3-12"FIL CON' level of filament heating inverter of pulse width modulation unit increases, filament heating inverter cut off, at the same time, the main power supply disconnects. When the rotary anode is driven abnormally, level of X2-4 "M-S" of driver A1 increases, the system detects the signal and generates anode default information "E04", the rotary anode driving stops and the main power supply is cut off.

During exposure, if the inverter components fails due to over-current or poor connection of power components caused by discharge in the high voltage circuit. protective circuit of inverter acts, port voltage of X1_6"OC_A" or X2_6"OC_B" of the converter drops under 4V, and the protective circuit of the pulse width modulation unit acts to cut off the output of pulse width modulation signal, and then the inverter stops. At this moment, the pulse width modulation circuit board (PCM 21003C) illuminates fault status LED and outputs low level to the main control unit, which then suspends and stops exposure, the main power supply is cut off, and default information "E01" or "E02" are sent to the console, in such a way, the mainframe hardware and software are protected.

Chapter IV Installation Instructions

Pre-installation inspection:


- Machine room layout meeting requirements;
- Connection to corresponding power supply;
- Installation of grounding facilities.

 **Note:**

- **Installation of equipment shall be completed by trained and authorized persons.**
- **The installer shall allow for easy operation of the equipment and sufficient space for maintenance during installation.**
- **Check for damage and obvious rain trace on external package.**

4.1 Unpacking inspection

- After unpacking the box, please check for completion good condition of parts and accessories per accessory list.
- Immediately contact your supplier in case of incompleteness or damage of parts.
- The accessory list is made based on your purchase contract.

 **Note: Keep the packing materials for reuse of them in future packing and delivery.**

4.2 Installation Flow

Fixing table→ Table installation→ Column installation→ X-ray tube assembly installation→ Controller panel installation→ Collimator installation→ Chest unit installation→ Electric lines connection.

4.3 Mechanical Installation

Step 1: Fixing table components. Move the table to designated position where punch fixed

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hole well in advance and fasten it with screws.

Step 2: Install the table panel. Loosen the hexagonal cylinder head mounting screws of the limit block, remove the block at one end, and the table panel will be pushed to the table components; the pulley on both sides of the table components must be slotted into the table panel's rail at the same time. After installation, slide back and forth to see if it is smooth; if not, you should adjust the pulley eccentricity at the ends of the components. Finally, fix back the limit block to the rail.

⚠ Caution: This step requires at least two people to operate simultaneously to avoid personal injury or equipment damage for the panel is heavy.

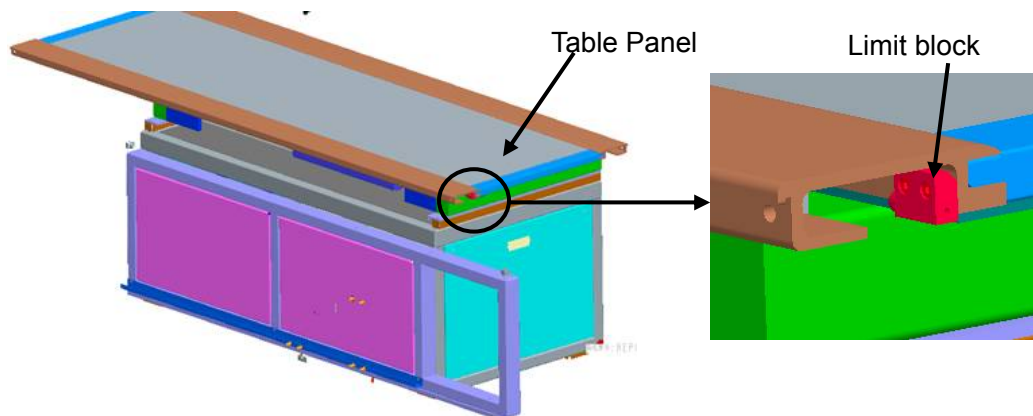


Figure 4-1 Table panel installation

Column pulley installation. First remove the limit block at one end of the rail, and then push the pulley into the rail gently, and then fix back the limit block to the rail. Glide the pulley back and forth to see if it can move smoothly; if not, it is necessary to readjust the eccentric screw on the pulley to adjust the flexibility of pulley.

⚠ Note: The cover plate should be taken down before adjusting the eccentric screw.

⚠ Note: The limit block should be installed before adjusting the eccentric screw.

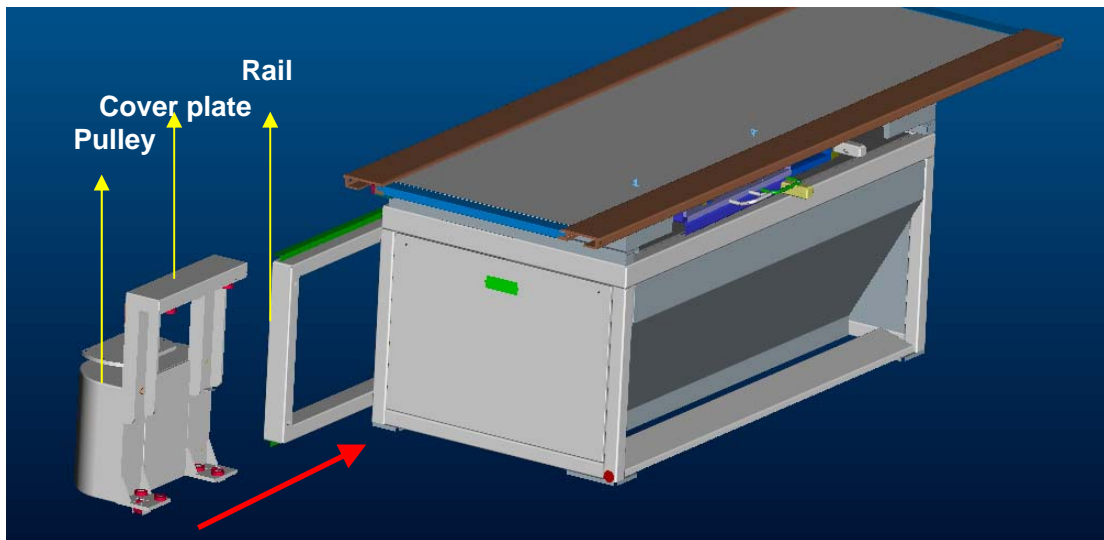


Figure 4-2 Pulley installation

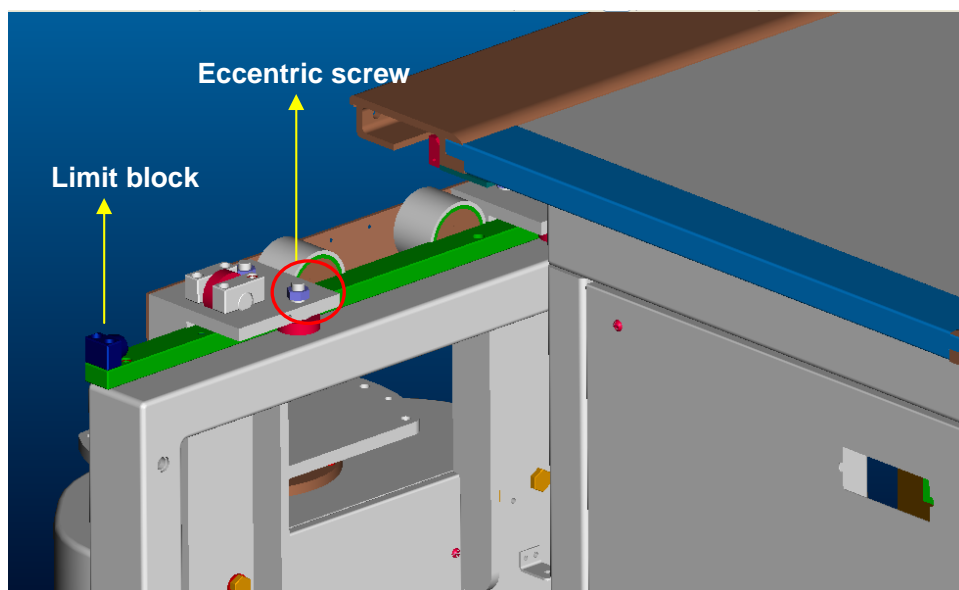


Figure 4-3 Eccentric screw and limit block

Step 4: The weights box installation. Foist the weights box into column from top of column; pay attention to wire rope, four-wheeled of weight box should resist the column's four angles.

⚠ Note: You should put 6-8 weights into the box to keep the balance of the column and support.

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⚠ Note: Check the wire rope which had fixed to the box before installation.

⚠ Note: The wire ropes should straighten out before installation, to avoid the wire is clamped between box and column at the installation process.

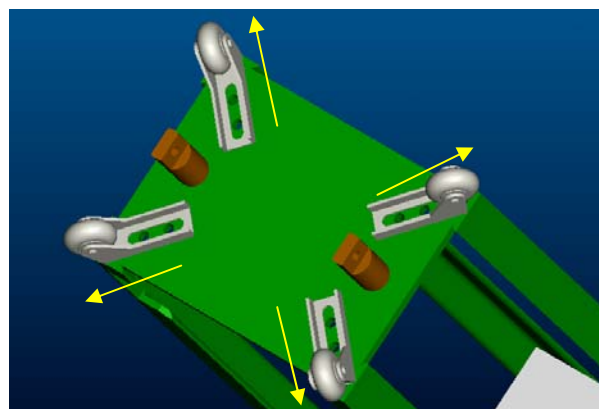
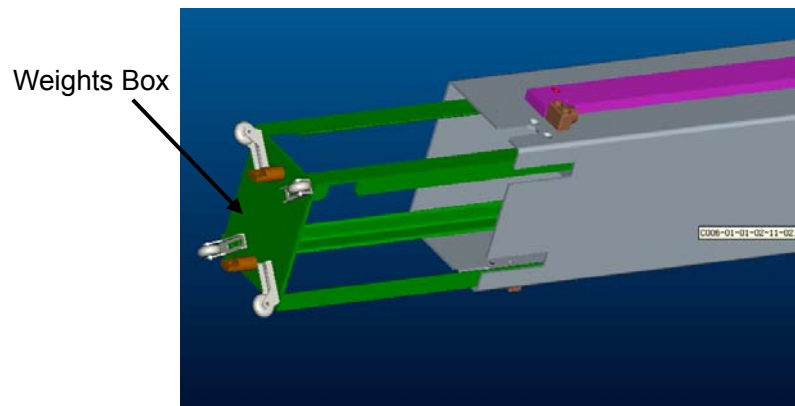


Figure 4-4 Weights box installation

Step 5: install the wire rope wheel at the top of the column and arrangement the wire rope to bridge over the wheel, and then fix the wheel with screws.

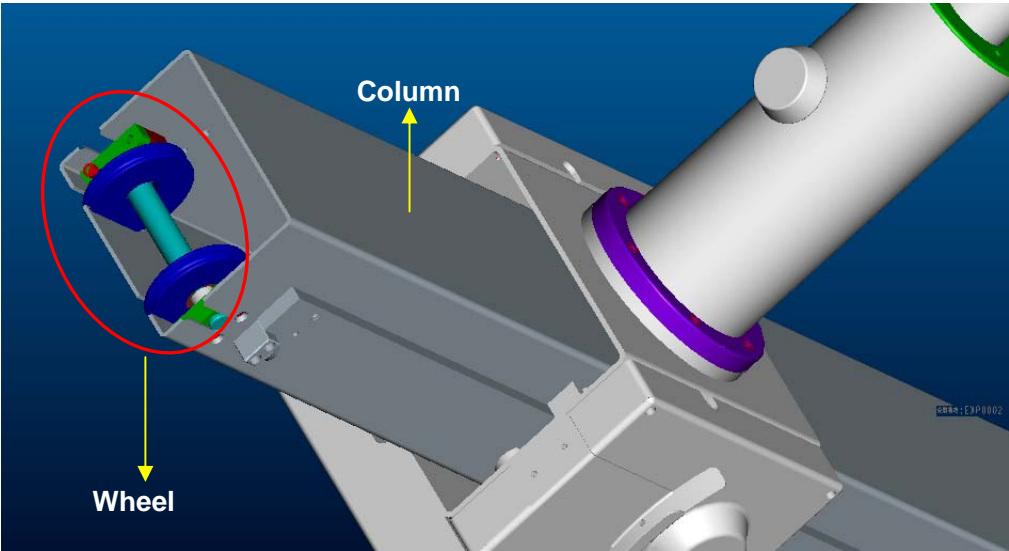


Figure 4-5 Wheel installation

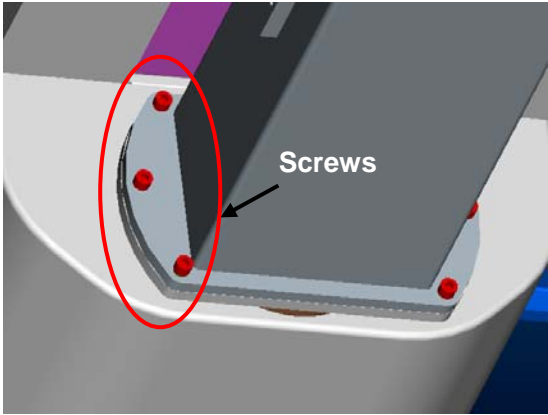
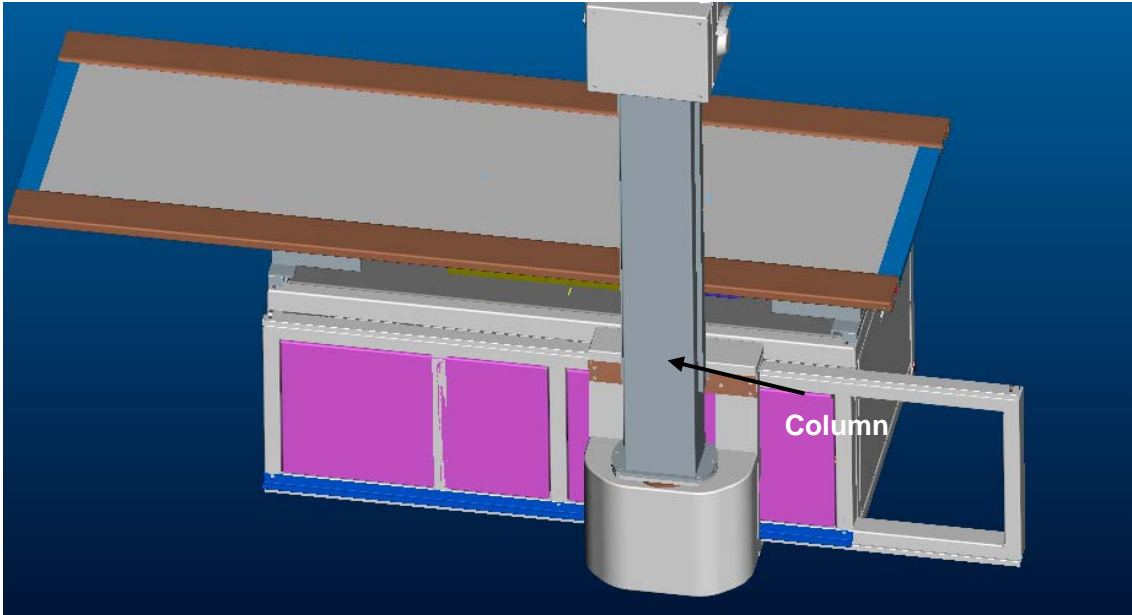


Figure 4-6 Column installation

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⚠ Caution: the tube support will rise after the weights have been laid; it needs one people to draw the tube support to avoid possible equipment damage.

⚠ Caution: As the column is heavy, this step needs at least four people to cooperate with the installation.

⚠ Warning: After this step, the quantity of the weights in the box should be adjust in time, to avoid the damage due to the drop down of the support.

Step 6: Put the X-ray tube on the support and fix it with four screws. Take attention to the direction of the tube, ensure the faucet for high-voltage cable must forward to the column as show as following figure. Then adjust the tube at horizontal state, finally screw down the taper dowel.

⚠ Caution: For the weights reasons, there is a person to need to pull down the tube support and keep at a appropriate location, and then another person install the tube at X-ray tube installation; and then release the support slowly to the top.

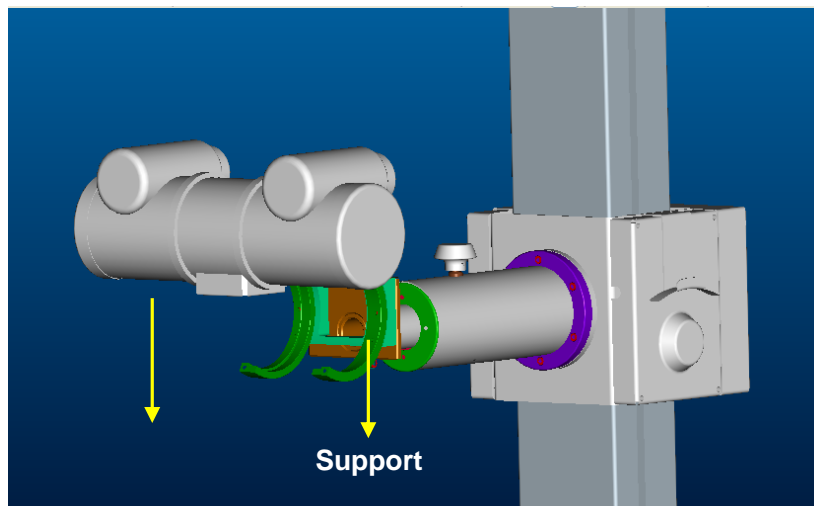


Figure 4-7 X-ray tube installations

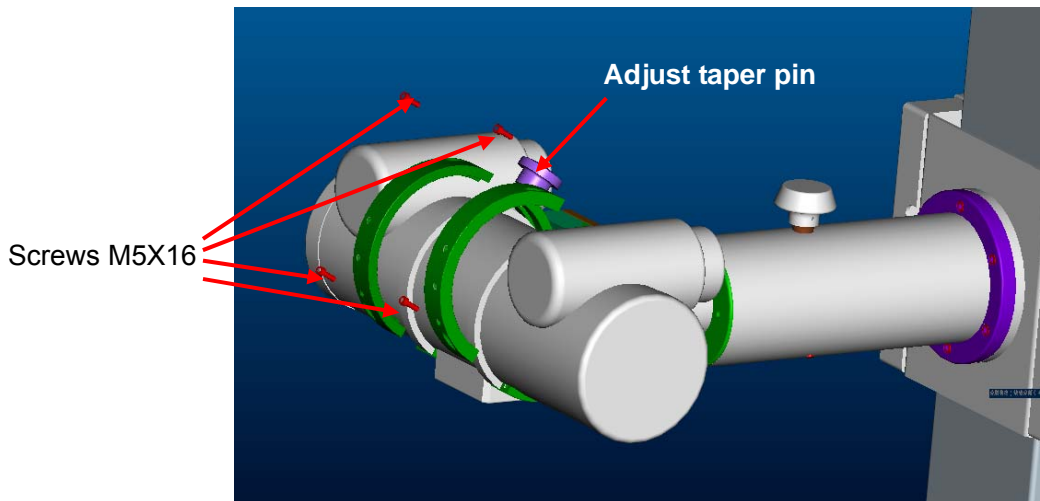


Figure 4-8 Fix the X-ray tube

Step 7: Collimator installation. Slightly loosened four cross screws of collimator, poke out two fixing brackets; install collimator on the controller panel, then poke in the brackets to buckle flange, fix four cross screws on collimator with spanner. Finally connect the wires of collimator.

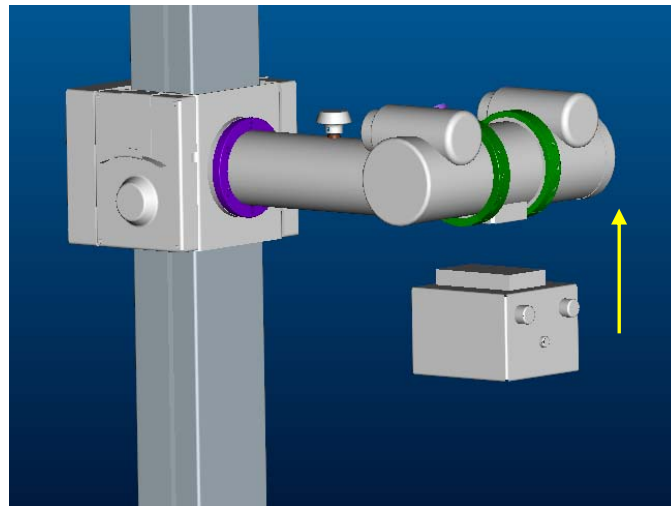


Figure 4-9 Collimator installation

⚠ Caution: When fix the screws of the collimator; the collimator should be supported to prevent the damage due to drop down.

Step 8: Control panel installation. Cover the control panel support at the tube support and fix with six screws.

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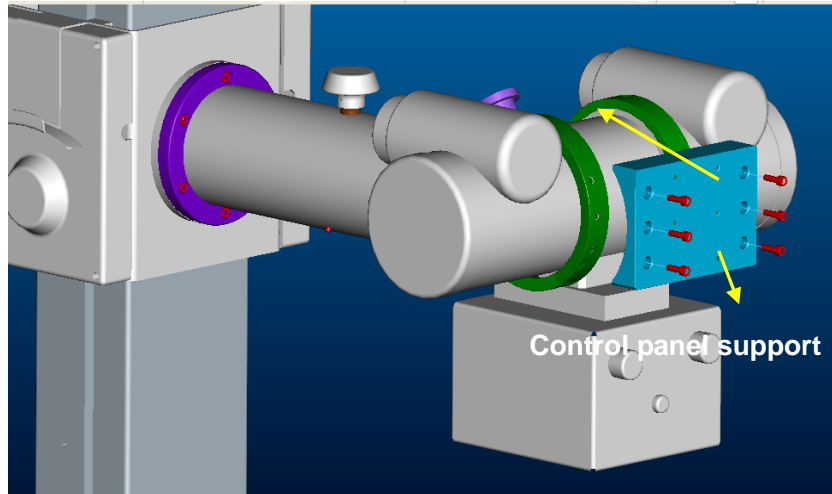


Figure 4-10 Control panel support installation

Step 9: Install the panel to the support and fix with six screws.

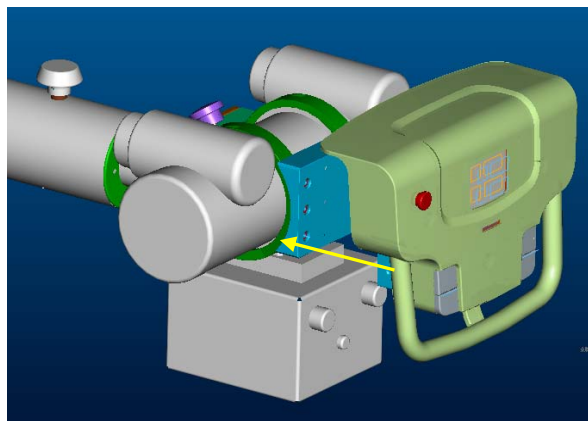


Figure 4-11 Control panel installation

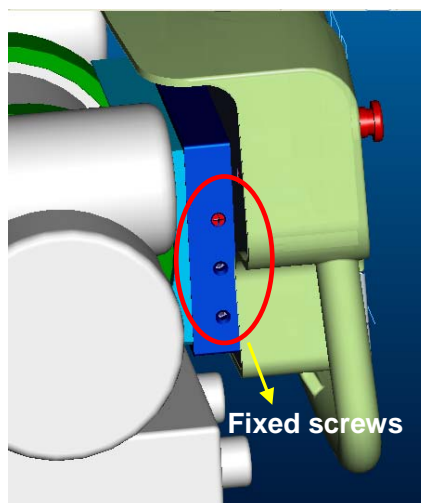


Figure 4-12 Control panel installation

Step 10: Connect the lines between X-ray tube and radiography table.

Step 11: Install the cover and shield of column.

Step 12: Chest unit installation. Rotate the tube with 90° and measure the distance between it and two vertex of chest unit film box by using tapeline, the discrepancy should not more than 2mm. Finally fix the chest unit to ground with four bolts.

4.4 Cable connection

4.4.1 Connection between generator and tube

Anode and cathode cables shall be arranged according to space arrangement (length of cable).

1. Connection of high voltage cable

 **Caution:**

- **Terminal plug of high voltage cable is subject to damage and shall be careful during use.**
- **These terminal plug shall be kept straight, and dowels shall be open (in parallel edge to edge).**

1) Accessories of each terminal plug shall be installed in accordance with instruction of cable manufacturer.

2) High voltage port of X-ray tube shall be kept clean. The whole surface of high voltage plug to be connected to X-ray tube including metal pin shall be coated a layer of silicon grease. Anode cable and cathode cable shall be carefully connected to corresponding X-ray tube input terminal. All connections shall be correct, anode and cathode directions shall be correct, Cable nuts shall be tightened.

3) The high voltage cable plug to be connected to the generator shall be coated a layer of silicone grease. The anode and cathode cable which have been connected with the X-ray

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tube shall be connected to corresponding generator plug. All connections shall be correct, anode and cathode directions are correct. Cable nuts shall be tightened.

2. Wiring of rotary anode motor cable

Function of X6 terminal of connector unit circuit board (PCB 21001E) is indicated in figure 4-13. Cable of rotary anode shall be correctly connected to X6 terminal of connector unit circuit board (PCB 21001E) of generator mainframe, As indicated in figure 4-14. The machine may drive middle speed tube (2800r/min), driving voltage setting of rotary anode is: start-up voltage of 160Vac, operation voltage of 40Vac and braking voltage of 80Vac, for adjustment, it is only required to shift one end of each power line (16#, yellow), operation power line (17#, red) and braking power line (18#, green) from terminal block (PCB 21008) to required voltage leading-out terminal on the terminal block. Selectable voltages and positions are indicated in figure 4-15.

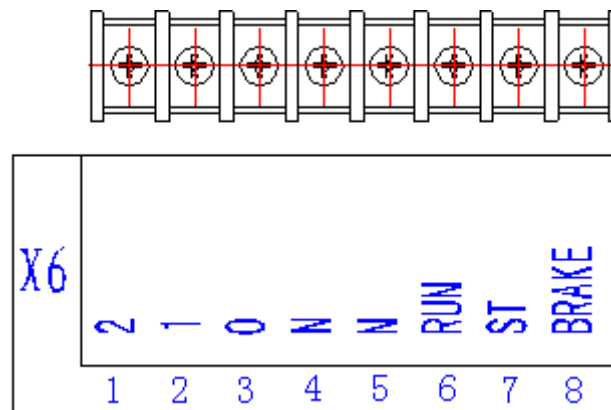


Figure 4-13 Port terminal X 6 (PCB 21001E)

1 Working winding driving output port of rotary anode (2)	5 Null (NC)
2 Starting winding driving output port of rotary anode (1)	6 Working power input port of rotary anode (RUN)
3 Driving output common port of rotary anode (0)	7 Starting power input port of rotary anode(ST)
4 Power null line (N)	8 Braking power input port of rotary anode (BRAKE)

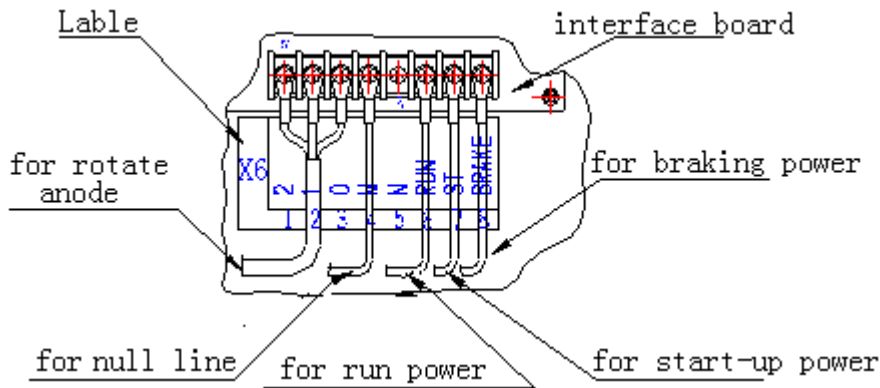


Figure 4-14 Installation diagram of rotary motor

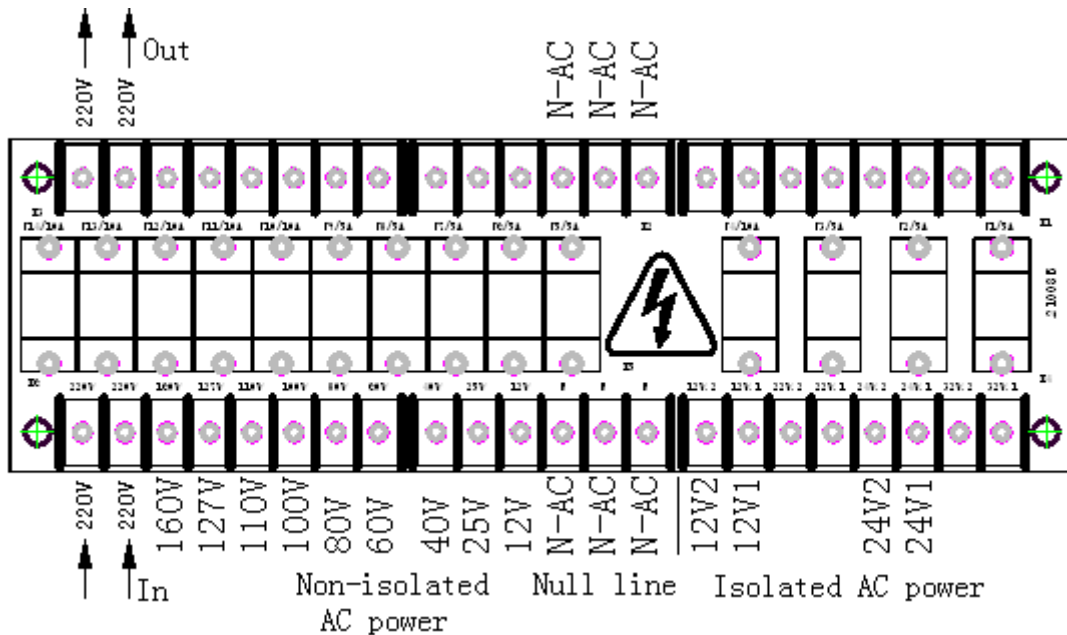


Figure 4-15 Terminal board (PCB 21008B)

⚠ Note: as indicated in the figure, incoming line end of live line goes out from live line leading-out terminal via fuse F14, two incoming lines and outgoing lines are short connected respectively via PCB short-circuit copper foil; two null line s are short connected via PCB short-circuit copper foil.

4.4.2 Connection of common radiography machine Bucky diaphragm

Function of X1 terminal of interface unit circuit board (PCB 21001E) is indicated in figure 4-16.

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Vibration winding of common radiography machine Bucky diaphragm or cold end connection wire of actuating motor stator shall be connected to low level end (such as null line) of Bucky diaphragm driving power, the hot end connector shall be connected to the 3rd terminal of X1 terminal of interface unit circuit board (PCB 21001E), and the high level end (such as live line) of Bucky diaphragm driving power shall be connected to the 4th terminal of X1 terminal of interface unit circuit board (PCB 21001E). If the Bucky diaphragm driving power needs 110Vac, which can be lead out from terminal block (PCB21008) as indicated in figure 4-15. Electrical connection of common radiography machine Bucky diaphragm finally completes after cable laying.

⚠ Note: Bucky diaphragm driving power high level connector shall be connected via fuse.

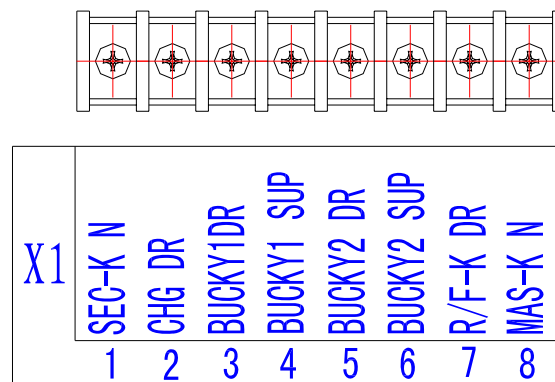


Figure 4-16 Interface terminal X1 (PCB 21001D)

1 Standby	5 Driving control port of Bucky diaphragm 2
2 Driving port of AC contact K1	6 Driving power port (such as null line) of Bucky diaphragm 2
3 Driving control port of Bucky diaphragm 1	7 Driving port of AC contact K3
4 Driving power port (such as null line) of Bucky diaphragm 1	8 Driving power port (null line) of AC contact

4.4.3 Connection of vertical radiography stand

Vibration winding of Bucky diaphragm or cold end connection wire of actuating motor rotator shall be connected to low level end (such as null line) of Bucky diaphragm driving power, hot end connector shall be connected to 5th terminal of X1 terminal of interface unit

circuit board (PCB 21001E), high level end of Bucky diaphragm driving power (such as live line) shall be connected to the 6th terminal of X1 terminal of interface unit circuit board (PCB 21001E). Electrical connection of common radiography machine Bucky diaphragm finally completes after cable laying.

⚠ Note: Bucky diaphragm driving power high level connector shall be connected via fuse.

4.4.4 Other connections

If radiography machine power supply is special, such as 110V/50Hz or 24V/50Hz, the power can be lead out from circuit board (PCB 21008) , as indicated in figure 4.

⚠ Note: Power capacity is limited as: $110V \times 2A = 220VA$, $24V \times 8A = 192VA$.

If localization light of collimator requires additional 12Vac power, which can be lead out from terminal 1st and 2nd of terminal X4 of circuit board (PCB 21008B).

⚠ Note: Power capacity is limited as: $12 \times 9 = 108VA$.

4.4.5 Connection of generator mainframe and console

The mainframe adopts flexible RS422/RS232 communication interface technology. If the console adopts RS 422, the core of RS422 shall be installed on D15 integrated block plug beside the communication socket before connection; if the console adopts RS232, the RS422 core shall be removed, and the core of RS232 shall be installed on D14 integrated block plug beside the communication socket

1. The pin plug of accessory communication cable shall be inserted in port X2 of mainframe control unit circuit board (PCB21002C), plug screws shall be tightened, as indicated in figure 4-17, and communication cable shall be properly laid.
2. Another end of communication cable shall be plugged into pin bed of console, as indicated in figure 4-16. Plug screw shall be tightened.

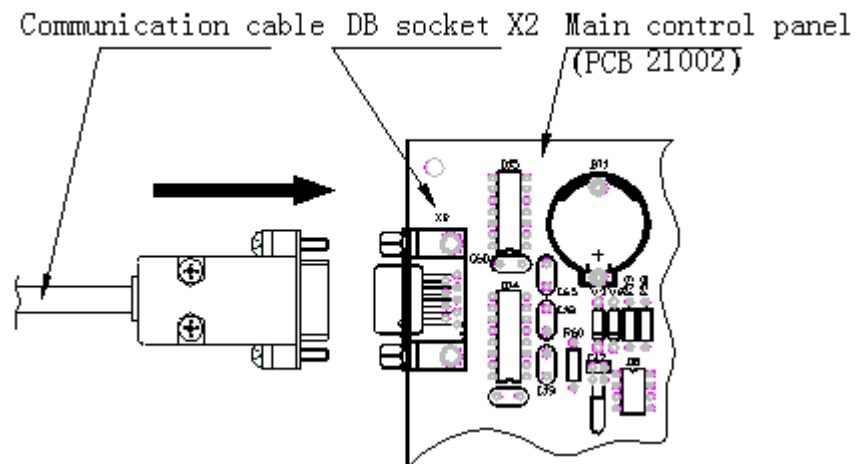


Figure 4-17 Connection diagram of communication cable

4.4.6 Connection of generator mainframe and power

1. Before power cable connection, user shall properly prepare electrical cabinet as indicated in figure 4-18 or electrical cabinet with equivalent function and emergency switch. Power cable shall be high quality multi-strand copper core insulation cable. When the three-phase-four-line power cable is used, protective earthing cable shall be yellow-green double color insulation high quality copper core multi-strand cable with cross section not less than 10mm².
2. Function of generator power interface terminal is indicated in figure 4-19.

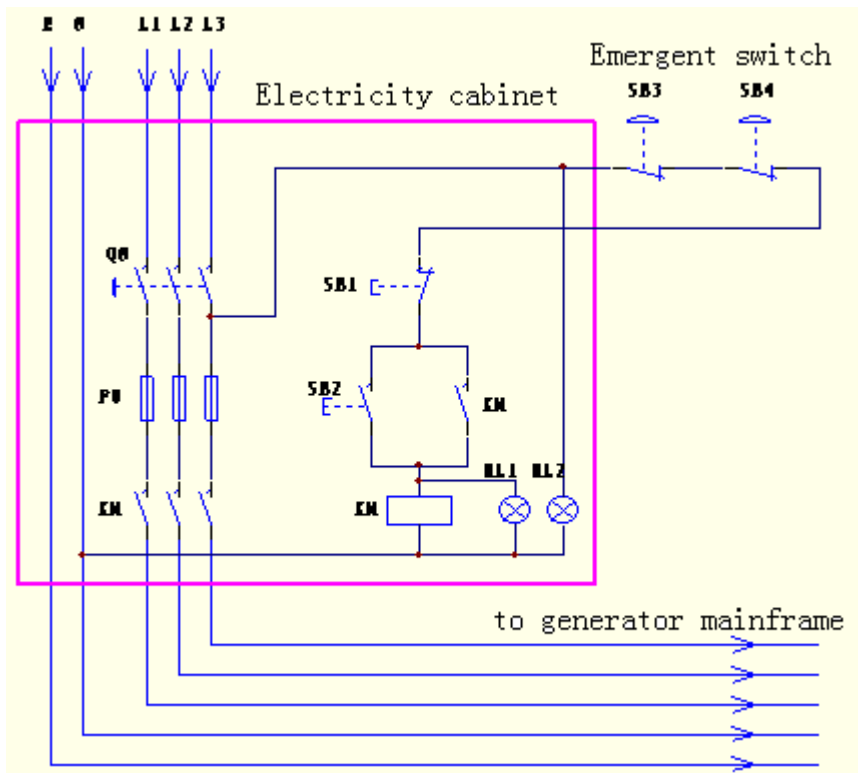


Figure 4-18 Arrangement diagram of X-ray room power

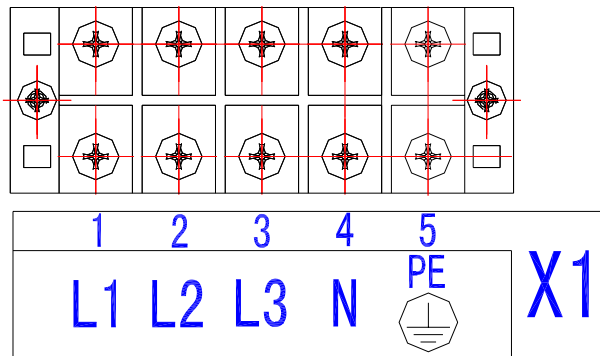


Figure 4-19 Power interface terminal X1

1 Power supply L1 phase interface (L1)	4 Power supply null line interface (N)
2 Power supply L1 phase interface (L2)	5 Protective earthing port (PE)
3 Power supply L1 phase interface (L3)	

Followings shall be noted during connection:

- a) It is proposed to install an emergency switch beside the console.

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- b) Circuit breaker power of electrical cabinet is off.
- c) The cable shall be cut off a proper length, and insulations on both ends of the cable shall be removed, and wire lug shall be connected through pressure welding.
- d) Power phase lines of L1, L2, L3 and null line (N) shall be connected to corresponding port on terminal block of power interface terminal X1, and protective earth shall be connected to PE terminal of power interface terminal X1.
- e) Power line shall be laid properly and connected to corresponding interface of electrical cabinet.
- f) Make sure that the emergency switch has been correctly connected to the electrical cabinet; when the emergency switch is pressed, generator power can be cut off.
- g) It is proposed to take out fuse tubes of three fuses of F1, F2 and F3 from generator mainframe, and then they shall be directly measured by multimeter on X1 of five power ends.

⚠ Note: contact resistance of protective earth line shall meet standard.

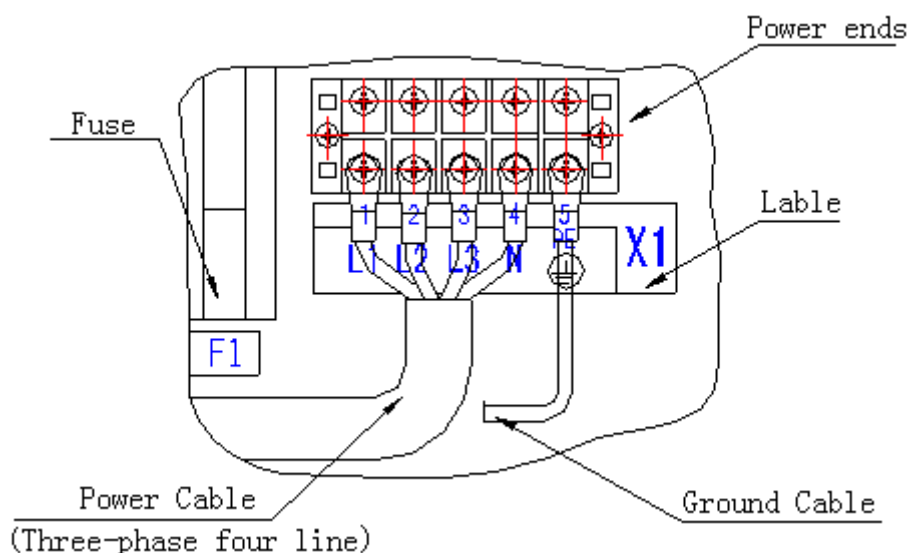


Figure 4-20 Wiring diagram of X1 terminal

⚠ Warning: the generator keeps connection with the power line, unless the circuit

breaker installed on the electrical cabinet is closed, or the safety switch on the generator is closed, the power will keep on.

 **Note:**

- Although the console is closed, the internal auxiliary power supply and control circuit of the generator still connects with the power line. Make sure that the system shall have been fully disconnected with the grid before repair and maintenance.
- X1-PE is protective earth port. Protective earth connector shall be copper line with cross section not less than 6mm²; The earth line shall be properly connected with special earth line.

Chapter V Calibration instructions

5.1 Collimator calibration

1. Manually operate the two knobs on collimator panel to calibrate X-ray beam range. At 1m position from focus, on the plane vertical to bed, selectable minimum X-ray beam size should be less than 15×15 mm.
2. Turn on indicate lamp switch, make up/down movement of tube focus, change SID, and check for light source center line deviation distance ≤ 10 mm. If it exceeds the range, check dolly installation status, loose tube anti-turn screws, and readjust tube angle.

Please refer to Collimator for more information.

5.2 Chest plane center alignment

Paste a small piece of lens onto film box center, and then weaken collimator light, estimate the lens area size, observe the position of reflected light; if the reflected light hit the central position of collimator, it means center alignment of chest plane has been achieved.

5.3 Tube calibration

1. Shut down mainframe power supply, connect high-voltage cable to host generator, start up the machine and calibrate tube.
2. Turn tube to "0" position, and SID to "100", and then put film box in film box plate; turn on light source of light collimator, place a marker on bed cross center and then, make exposal to check for deviation of X-ray source from film box center, which should be ≤ 10 mm. If it exceeds the range, readjust light source of light collimator and make another exposal for further check.

5.4 Generator Calibration


5.4.1 Preparation before debugging

1. Debugging or detection instrument shall be as follows:
 - 1) Storage oscillograph Tektronix TDS210 or similar products
 - 2) Multimeter

- 3) Digital milliammeter (optional)
 - 4) Digital milliampere-second meter (optional)
 - 5) Voltage box (optional)
 - 6) X-ray dose tester (optional)
2. Before energization, all power terminals and connectors shall be scrutinized to eliminate short-circuit or open-circuit and etc, to ensure correct and firm connection.
- 1) Protective earth shall be specially checked for reliable connection, and shield of high voltage cable shall be specially checked for reliable connection to the ground.
 - 2) High voltage socket of oil tank shall be checked for reliable connection to tube anode and cathode.
 - 3) If tube current is directly tested, two ends of mA detecting point on the oil tank shall be checked to make sure reliable connection with mA detector.
 - 4) Resistance of the 2nd terminal (macro focus end) against 1st terminal (common terminal) of X 5 terminal of pulse width modulator (PCB 21003C) and resistance of 3rd terminal (minifocus) against 1st terminal (common terminal) shall be measured by multimeter ohm position, and the resistances shall be zero.
 - 5) When resistance of 5th terminal against 4th terminal of terminal X2 on pulse width modulator (PCB 21003C) is 4.7k Ω ($\pm 0.5k\Omega$) measured by multimeter, this indicates that the +kV sampling circuit is normal; When resistance of 6th terminal against 4th terminal of terminal X2 on pulse width modulator (PCB 21003C) is 4.7k Ω ($\pm 0.5k\Omega$) measured by multimeter, this indicates that the -kV sampling circuit is normal; When resistance of 1st terminal against 3rd terminal is 10k Ω ($\pm 0.5k\Omega$), and when the machine is in fluoroscopy mode, the resistance of 1st terminal against 3rd terminal is 200k Ω , this indicates that the +mA sampling circuit is normal, when resistance of 2nd terminal against 4th terminal is 0k Ω , this indicates that the -mA sampling circuit is normal (-mA has been reliably connected with earth end).

5.4.2 Test of rotary anode

This test requires two operators, one operates console, the other operator observes rotating speed of anode of X-ray tube. When the position 1 of hand brake switch is pressed, rotating speed of anode shall be checked and the start up of anode shall be normal.

 **Note: during test, exposure shall be avoided; otherwise, operators approaching to the X ray tube may suffer X-ray radiation.**

5.4.3 Calibration of tube voltage

Before ex-factory, KV value of the machine has been correctly calibrated, in general, recalibration is not necessary, however, if necessary, following steps shall be followed for recalibration:

1. Protective unit (PCB 2100108A) TP1 is test point of +kV value, TP3 is test point of -kV value and V4 cathode is earth clamping end.
2. At test point of kV value, ratio of voltage value to kV is 1V:10kV, hot end of **digital storage oscilloscope** probe 1 is clamped to test point of +kV value, cold end is clamped to measuring earth, hot end of probe 2 is clamped to test point of -kV value and cold end is clamped to measuring earth. (or apply volt box or other measuring instrument) .
3. Voltage of 21002 C panel TP2 shall be 3.20V ($\pm 0.05V$) measured, otherwise 21002 B potentiometer RW3 shall be finely adjusted; Voltage of 21002 C panel TP3 shall be 0.57V($\pm 0.05V$) measured, otherwise potentiometer RW2 shall be finely adjusted;
4. Parameter selection of calibration point: minifocus, 50mA, 100ms, 40kV (note: voltage on one side is half of this kV value.)
5. Exposure, adjusted pulse width modulator 21003C potentiometer RW1 (adjustment + kV value), RW2 (adjustment -kV value) (kV value increases in clockwise adjustment and reduces in counterclockwise adjustment), and then exposure and fine adjustment shall be

repeated till correct calibration is achieved (error less than 5%).

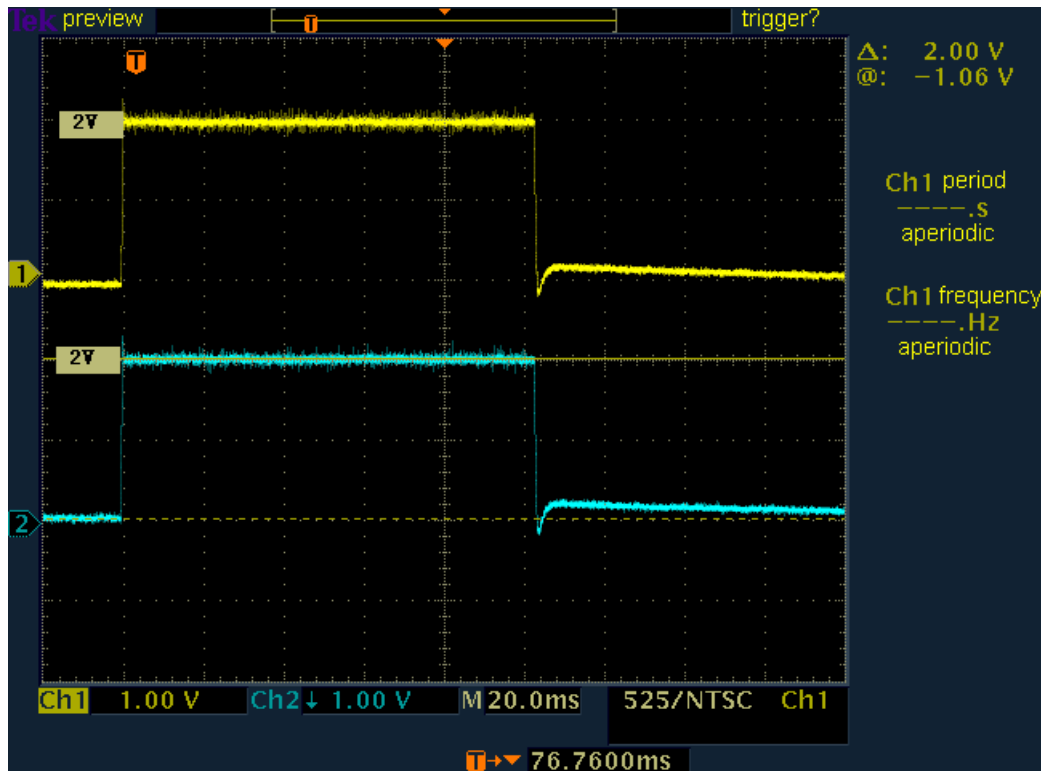


Figure 5-1 waveform of output voltage

6. Voltage calibration of the tube has been completed.

5.4.4 Calibration of tube current

Calibration of tube current is realized by setting the tube current through changing corresponding byte in filament current data ROM. Data corresponding to each setting value varies with different parameters of tube and high voltage cable. Even in a same tube, after a period of time, the setting current may deviate from the actual tube current, therefore, the tube current shall be subject to preliminary calibration after installation; during use, regular calibration shall be performed at 6 month or shorter interval. Calibrated data are stored in nonvolatile memory chip, which locates on PCB of mainframe control unit.

When tube current is directly measured, current measurer has special requirement to shortest sampling time for measurement, such as continuous measurement sampling time

Service

of milliampere-second meter is longer than 70ms, continuous measurement sampling time of current position of common digital multi-meter is longer than 500ms, to shorten time for calibration and reduce X-ray radiation hazard to calibrators, it is proposed to adopt current resistance sampling for indirect measurement, which adopts storage oscillograph to measure voltages on both ends of sampling resistance.

During tube current calibration, the storage oscillograph is used as measuring tool, Tektronix TDS210 storage oscillograph is proposed to use, test point of tube current is at R27 (has been lead out with by resistance) of protective panel (PCB 200108A). At this point, ratio of voltage to tube current is 1V:100mA (in fluoroscopy status, the ratio of voltage to tube current is 200mV:1mA); the cold end of storage oscillograph probe shall be clamped at V4 cathode (GND) on panel, and hot end shall be clamped at R27 (lead out with resistance).

Radiography tube current shall be calibrated as per following steps:

- 1) Press "S/mAs" key till two "Di" sound, ant then release the key, then the system is in maintenance status.
- 2) Press radiography kV increase/decrease selective key to display "2" in radiography kV display screen, at this moment, modification of password unit is selectable.
- 3) Press radiography mA increase/decrease selective key to display modification password "88" on radiography mA screen.
- 4) Press "storage key" to store this value
- 5) Press "RST" key to return to standby condition.
- 6) Select focus. such as minifocus
- 7) Press S/mAs increase/decrease key to set the exposure time to 25ms.
- 8) Press mA increase/decrease key to preset mA value.
- 9) Press kV increase/decrease key to set kV value to 45kV.

- 10) Press "S/mAs" key till four "Di" sound, S/mAs display screen indicates "P"; release the key.
- 11) Press S/mAs increase/decrease key to display data to be input in S/mAs display screen, such as "P 80".
- 12) Press "storage key" to store this value.
- 13) Perform exposure action under this condition.
- 14) Read storage oscillograph recorded value. if recorded value is higher than setting value, value in S/mAs display screen shall be reduced, on the contrary, the value shall be increased.
- 15) Repeat 11)--14) steps till record value of oscillograph is in line with the setting value, and then the calibration of combined parameter of kV value and mA value has completed.
- 16) Increase kV value by 10kV, repeat 11)--15) steps to calibrate this combined parameter.
- 17) Repeat step (16) till mA calibration completes.
- 18) Repeat steps 6) --17) to calibrate another mA.

5.4.5 Test Bucky diaphragm

If ready key is pressed in safety condition, the electric Bucky diaphragm shall operate; if exposure key is pressed, the vibrator Bucky diaphragm shall vibrate. When exposure finishes, the Bucky diaphragm shall stop.

5.5 Commissioning

After debugging and in normal operation condition, test card or water bag maybe used as test piece for radiography to determine normality of the machine.


Chapter VI Maintenance

In order to ensure the continued safe operation, X-ray machine should carry out regular maintenance. There are two aspects of the maintenance, one is by the user or operator maintenance, and the other is by qualified service personnel. The manufacturer bear to provide at least 5 years supply of spare parts after the machine manufacturers.

6.1 Operator Maintenance

1. After one-week operation, user may spray Pledge on equipment surface, and then wipe the surface with dry gauze or tower.
2. After each operation, user shall thoroughly wipe the table panel surface with gauze dipping with medicinal alcohol.

Pay attention to the following information for maintenance by users:

 Caution: Do not remove the casing or internal elements in the cabinet and console. Damage to personnel or the machine caused by ignoring this attention is no responsibility of the manufacturer.

1. When the x-ray generator is working, do not clean any part of it. Do cleaning after the generator is shut down and the power is turned off.
2. Clean the machine frequently, esp. when there is corrosive matter. Spray inorganic detergent on a piece of rag and use the rag to clean the machine casing. Do not use vacuums or organic solvents for cleaning.
3. Keep the machine room tidy, dry and airy. The machine shuns heat and the sun.
4. Replace the dewatering filler vaseline in HT connectors periodically. For connectors used for HT generator components the replacement is done once less than a year; for connectors used for x-ray tube components, the replacement is done once less than half year. Intensify examination and updating during the summer or when there is heavy work.

5. Pay attention to the condition of power supply. Check if its internal resistance (or voltage drop) has changed. Make efforts to realize the requirements for the power supply of the machine.

6. Check the grounding device frequently to make sure all parts are safely and reliably grounded.

6.2 Overhaul

 **Note: This step shall be performed only by trained service personnel.**

1. User shall regularly check dust inside through front and back covers after half or one year of operation, as the case may be. Check shall focus on various switches and contacts for their electrolytic corrosion and uncleanness, which shall be wiped out with gauze dipping with medicinal alcohol, switches and contacts suffering serious corrosion or pollution shall be replaced. In addition, components and wiring connectors shall be checked for loose and displacement, tighten them, if required.
2. During operation, power voltage shall be maintained in normal level. In the event of occurrence of over-high, over-low, surge voltage and other abnormalities, the operation shall be suspended till the cause has been found and trouble-shooting measures have been taken accordingly.
3. All knobs and keys of the controller shall be gently operated; overexertion shall be avoided to prevent dislocation, damage or poor contact, even breakage.

Chapter VII Troubleshooting

7.1 Error Code

The generator is capable of self-diagnosis. It can give signals to report big problems, helping with repair a lot. For trouble-shooting, normally, check the power supply system first and then the auxiliary power supply of the generator.

When the system goes wrong, the KV screen on the console will display the corresponding error code as the figure 7-1 shows:



Figure 7-1 Error code illustration

Fig. Error code display

Error code	Where and what is the problem?	Trouble-shooting
E00	Abnormal power or fault of input circuit	Check normality of AC power and replace the circuit board of the interface unit.
E01	Overcurrent or fault of inverter discharge of BR1. X-ray tubes or HT parts and lead to over-loading.	Check HT circuits and the inverter and replace faulty parts.
E02	Overcurrent or fault of the inverter discharge of BR2. X-ray tubes or HT parts and lead to over-loading.	
E03	Failure of cathode heating or the fault of heating driver circuit	Check HT circuits and the bulb tube and filament heating circuit and replace faulty parts.
E04	Failure of anode heating or the fault of anode heating driver circuit	Check anode motor circuits and anode drivers and replace faulty parts.

E05	The machine fails to start.	Cut off all power supply, start the machine two minutes later. if the trouble is still there, check the interface board, communication cables and the console.
E06	The machine fails to shutdown.	Cut off all power supply, start the machine two minutes later. if the trouble is still there, check the interface board, communication cables and the console.
E07	Self-diagnosis fails.	Controlling system hardware problem; to be checked. Parts to be replaced.
E08	Resetting fail.	
E09	The internal radiating port fails.	
E10	The protective circuit of the inverter fails.	
E11	The focus switching fails.	
E12	The Bucky diaphragm fails	Check normality of electrical connection of Bucky diaphragm
E13	Positive deviation of tube voltage.	Calibrated.
E14	Negative deviation of tube voltage.	
E15	Positive deviation of tube current	
E16	Negative deviation of tube current	
E17	Positive deviation of voltage reference.	
E18	Negative deviation of voltage reference	
E19	Positive deviation of current reference	
E20	Negative deviation of current reference	
E21	Invalid parameters	
E22	Invalid orders	
E23	Automatic reset of main system	
E24	EEPROM is not initialized	Initialized debugging performed.

7.2 Key point in fault diagnosis

In case of system error, fault causes can be diagnosed rapidly through checking test point

Service

and signal indicator of corresponding parts, and trouble-shooting may be performed quickly to recover normal operation of the system.

7.2.1 Console

After switching the power supply on, the control system is energized and begins to self inspection. Console luminescent indicators flashes to help repairman to perform inspection. After self inspection, kV screen displays "OFF" or "E"; "E" indication is normal since last operation shuts down and losses power abnormally. If the console has no reaction after switching-on, or "E00" is displayed, this may be caused by abnormal power supply system, and following inspection steps shall be followed:

- a) Is the power supply normal?
- b) Is the mainframe cabinet fuse normal?
- c) Are L1, L2 and L3 phase powers are normal ?
- d) Is auxiliary power $\pm 12V$ is normal?
- e) Is communication cable connected correctly?
- f) Fault of console.

When "ON" key of the console is pressed, the system begins soft-start; kV display screen displays initialization accounting. After soft-start, main power source is connected, the console shall display normal X-ray radiography parameters.

7.2.2 Interface unit (PCB 21001E)

The interface unit is equipped with LED status indicator and reference voltage precision potentiometer. Item code and information of LED indicator is as follows:

1. V42--filter unit stored energy status indicator lamp. Illumination of V42 indicates electrification of capacitor. When charge voltage remained in the capacitor is less than 10V, V42 blacks out. Note! Power shall be off at least 3minutes prior to complete

discharging of the capacitor! Black V42 does not mean complete discharge.

2. V19---On indicator. When "ON" key is pressed, the lamp shall illuminate. If black, the machine will not start, port X3-7 shall be checked for level. If level is low, connection line with main control unit (PCB 21002) shall be checked; if level is high, this unit (PCB21001D) or null line and all phases L1, L2 and L3 shall be checked.

3.V20---Bucky diaphragm 1 Working status indicator. If Bucky diaphragm 1 is selected, the indicator illuminates during exposure preparation and at the moment of exposure.

4.V20---Bucky diaphragm 2 Working status indicator. If Bucky diaphragm 1 is selected, the indicator illuminates during exposure preparation and at the moment of exposure.

5.V22----Ready-start status indicator. When the machine is ready for start, the indicator illuminates, X3-7 is at high level. If black, the machine cannot start up, and the console displays "E00", in this case, check shall be performed according to potentiometer RW3, which is pre-charging voltage regulation potentiometer, TP4 point beside is level test point.

(1) If pre-charging voltage exceeds 380VDC and V22 is black, the console displays "E00" or continuous counting, this may be caused by modified feature of components of pre-charging voltage monitoring circuit. Press "OFF" key till LED V42 blacks out, finely adjust RW3 (level at TP4 point decrease) to set low pre-charging voltage, repeat start-up, fine adjustment and detection till pre-charging voltage reaches to 380VVDC and AC contact K1 attracts.

(2) If pre-charging voltage is lower than 380VDC, V22 illuminates, AC contact K1 of main power supply line attracts, the mainframe starts up, after long run operation in this status, service life of energy storage filtration capacitor (PCB 21007) will be shorten. Finely adjust RW3 (level at TP4 point increase) in counter clockwise to increase pre-charging voltage to 380VDC.

6. V45·····Rotary anode working signal lamp. During standby, the lamp blacks out.

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When the Ready key is pressed, the indicator lamp shall illuminate, otherwise, it indicates that exposure ready check is not passed, the console displays "E04", in this case, voltage at port X6_6、X6_7、X6_8 (against X 6-4) shall be checked for normality. If abnormal, corresponding connection wire and fuse and power transformer T1 on terminal block (PCB 21008) shall be checked; if normal, voltage at X5-5 port shall be checked for low level after pressing the exposure Ready button, if low, this connection wire and main control unit (PCB21002) shall be checked, otherwise, the unit (PCB 21001E) shall be replaced.

7.2.3 Mainframe control unit (PCB 21002C)

Normal start-up indicates that mainframe micro processor's function and communication interface are normal. Normality of other I/O interface may be traced and checked through observing normality of other units. If it is required to replace mainframe control unit circuit board, the non-volatile store D1 for storing calibration data on original circuit board shall be shifted to newly replaced circuit board. See figure 7-2.

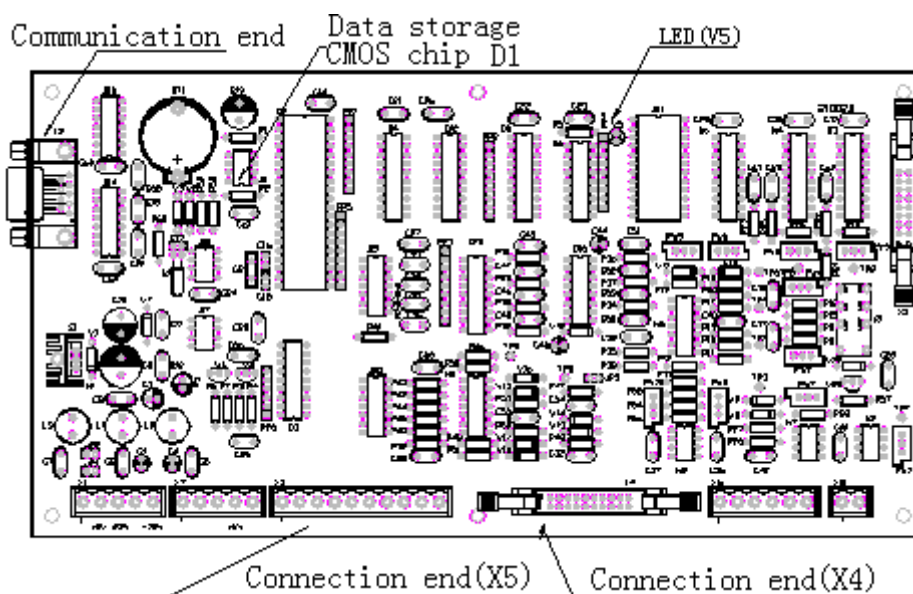


Figure 7-2 Main control unit printed circuit board (PCB 21002C)

7.2.4 Pulse width modulation unit (PCB 21003C)

The pulse width modulation unit is equipped with 8 LED status indicators and two kV calibration precision potentiometers.

1. V7----Fluoroscopy/radiography status indicator. The indicator illuminates during fluoroscopy and blacks out during radiography.

2. V23----inverter BR1 protection test indicator. The indicator illuminates during standby status, when "ON" key is pressed to reset the machine, the indicator blacks out.

3. V24----inverter BR2 protection test indicator. The indicator illuminates during standby. When "ON" key is pressed to reset the machine, the indicator blacks out.

4. V35---Inverter BR1 fault indicator. The indicator illuminates during standby. when "ON" key is pressed to reset the machine, the indicator blacks out. During exposure, if this indicator is black and exposure is abnormally interrupted, this indicates that inverter BR1 is in overcurrent protection status, the console displays "E01", and repair shall be performed according to steps as follows:

(1) Press clear key or restart machine, select lowest value of 40kv, lowest mA, 250ms and perform exposure with this parameter.

(2) If exposure is normal, select 80kV and maintain other parameters unchanged, and re-exposure.

(3) If exposure is normal, select 120kV and maintain other parameters unchanged, and re-exposure.

(4) If normal, preliminary judgment may deny the existence of discharge fault in high voltage circuit

(5) If a same fault (fault "E01") occurs during these three exposures, this indicates that the machine is subject to serious interference or indicates existence of discharge fault in high voltage circuit or fault in power circuit, in this case, communication cable, earthing,

Service

high voltage connection (high voltage plug, socket and cable) , tube, inverter, high voltage oil tank, main control panel and console shall be checked for normality.

5. V32---Inverter BR2 fault indicator. Ditto perform check.
6. V31--inverter working status signal lamp. The lamp illuminates during standby or protection; during exposure, the lamp blacks out.
7. V38---filament heating status indicator. The indicator blacks out during standby or abnormal status; presses Ready key, filament is heated, and this indicator illuminates, if this indicator is black, this indicates abnormal heating, the console displays error code "E03", and repair shall be performed as follows:

(1) Is filament heating data normal ?

(2) Is communication flat cable connection among pulse width modulation plate and main control panel are normal?

(3) Is filament heating auxiliary power normal?

(4) Is filament transformer driving circuit normal?

(5) Is filament normal?

(6) Replace this unit circuit board.

8. V67---focus working indicator. The indicator illuminates during large focus and blacks out during small focus. When focus selection key is pressed, V67 is in corresponding working status.

9. Potentiometer functions are as follows:

(1) RW1----+kV adjust potentiometer, turn clockwise to increase +kV, turn counter-clockwise to reduce +kV.

(2) RW2-----kV adjust potentiometer, turn clockwise to increase -kV, turn counter-clockwise to reduce -kV.

7.2.5 Auxiliary power

In case of fault of filament heating auxiliary power +48V, press of Ready key may display error code "E03".

7.2.6 $\pm 12V$ auxiliary power (PCB 21021)

Fault of $\pm 12V$ auxiliary power may cause no reaction of console or continuous counting after switch-on, the main power cannot connect.

- a) E00 code: indicate failure of start-up. A possible damaged part is interface unit (21001E) or tube overheating protection.
- b) E01/E02 code: indicate overcurrent protection of generator. A possible damaged part is inverter or tube discharge or grid voltage exceeds power requirement.
- c) E03 code: indicate failure of filament heating. Possible damaged part is pulse width unit (21003C) or poor contact of 48V power or high voltage cable cathode or burn out of tube filament.
- d) E04 code: indicate start failure of tube rotary anode. A possible damaged part is burn out of interface unit (21001E) or tube rotary anode power fuse or abnormal rotation of tube rotary anode.

Chapter VIII Technical description

1. Filtration of X-ray tube assembly

Additional filter 1.5mm Al equivalent, total filtration exceeds 2.5mm Al equivalent.

2. Limitation of X-ray equipment radiation beam

Range of X ray radiation beam is adjustable through manual operation of two knobs on the collimator panel. At 1m away focus and on the plane perpendicular to the tabletop, selectable minimum size of X ray radiation beam shall be less than 15mm x 15mm.

3. Position of reference axis and distance between focus and image receptor

During normal operation, reference axis of X-ray field is perpendicular to the cassette. Notch of the cassette clamp shall be aligned with reference light of radiation field if required during radiography. X-ray source assembly is adjustable continuously; SID value can be read on scale of the column.

4. Corresponding relationship between X-ray field and image receptor

1) Under the circumstance that the cassette plane is perpendicular to the reference axis (3° tolerance) , the measurement shall indicate that the sum of deviations between edges of the receptor and edges of X ray field shall be not more than 3% of SID indicator value.

2) Sum of deviations between X and Y axial directions shall be not more than 4% of SID indicator value.

5. Distance between focus and skin

To minimize and rationalize patient's absorption for radiation, the operator shall maintain distance between focus and skin as longer as possible.

6. Attenuation of X ray beam

To prevent excessive attenuation of X-ray beam caused by the material inserted between patient and X film, the tabletop panel adopts medium dense laminated panel.

7. Control of protection area

Radiography machine and console shall be installed separately. During loading, operator or staffs are not required to approach the patient; the generator mainframe may carry out following isolated control functions:

- 1) Selection and control of operation method
- 2) Selection of loading factors
- 3) Action of radiation switch

8. Position of focus and tolerance between focus and reference axis

Position of focus and tolerance between focus and reference axis is 55.4 ± 0.37 .

Service

Attached schedule—spare parts

1. Wearing parts:

NO.	P/N	name	Standard/type	PCS
1	47010003	Fuse	Φ5×20, 2A/250VAC	3
2	47010004	Fuse	Φ5×20, 6A/250VAC	1
3	47010005	Fuse	Φ5×20, 8A/250VAC	1
4	39160007	Fixed three-port Monistat	TO-220 package, LM7805	1
5	39160009	Fixed three-port Monistat	LM78H24, TO-3 package	2
6	39100008	IC	DIP14, 74LS06	3
7	26030011	Halogen tungsten lamp	24V 100W	1
8	48030055	Small-size Emergency stop switch	Φ23.6×40, mounting hole Φ16, LAS1-A	1
9	48030035	Reset key-switch	Φ23.6×40, mounting hole Φ16, LAS1	4

2. spare parts:

NO.	P/N	name	Standard/type	PCS
1	27030003	Colligation Board	LWX-50P Colligation Board	1
2	27030001	Power Supply Board	LWX-50P Power Supply Board	1
3	27030002	Control Panel	LWX-50P Control Panel	1