MUX－100D SERIES SERVICE MANUAL

SHIMADZU CORPORATION
KYOTO JAPAN
Medical System Division

5 PCB EXPLANATION

6 ADJUSTMENT/REPLACEMENT OF EACH PART

7 Trouble shooting

1-1 Features

Light traveling

Silent and light traveling operability is realized by the power assist.

Compact design

With good front field of view, the system can move freely even in a narrow space.

Free positioning

Prompt and free positioning is enabled by movement of the main body by the fine movement switch and operation of the tube unit in the column turning method.

Adoption of high-frequency inverter

Outputs with excellent X-ray generation efficiency and low ripple are realized by adoption of a high-frequency inverter at 60 kHz maximum as the high voltage generation method.

Anatomical programs provided as standard

With anatomical programs provided as standard, the exposure condition can be set easily.

Cable-less system

With built-in batteries, scans can be performed without connection of the power plug.

Plain indicator

The large indicator provides a plain indication of proceeding from the preparation to the completion of an exposure.

Flat Panel detector

This unit uses a digital flat panel detector to capture images directly without using film or CR and can display reference images quickly after exposure.

1-2 Specifications

		MUX-100D	MUX-100DJ
Use environment			
	Atmospheric pressure	700～1060hPa	
	Ambient temperature	10～35℃	
	Relative humidity	30～75%	
Common specifications			
	Total width	580mm	
	Total length	1250mm	
	Height of support stand	1930mm	1780mm
	Weight	394kg (with imaging unit)	
	Maximum running speed	5±0.5km/h(this may vary depending on the floor condition.)	
	Imaging unit storage	1 Imaging unit and 1Gid	
	Focus height	600～2010mm	600～1860mm
	Arm length	635～1200mm	
	Support stand rotation range	±270deg min.	
	Tube rotation angle	360deg	
	Tube rotation around tube axis	Forward: 90 deg min.; Backward: 20 deg min.	
	Minimum distances between Focal Spot and Image Receptor	312mm	
Power supply			
For battery drive:	Supply voltage	Built-in battery	
	Battery type	Shielded lead storage battery (12 V×20 cells)	
For battery charge:	Rating of power supply	1kVA	
	Supply voltage	Single phase AC 100,110,120,200,220,230,240V	
	Supply Impedance	Single phase AC 100,110,120 V : No more than 1.0Ω Single phase AC 200,220,230,240 V : No more than 4.0Ω	
	Supply frequency	50/60Hz	
Power cable length		4m	

			MUX-100D	MUX-100DJ
High-voltage generator				
Nominal electric power			12.5kW (100kV、125mA、0.1s) (The product of the current allowed to flow for 0.1 seconds at a tube voltage of 100 kV and tube voltage)	
Ratings	The nominal maximum tube voltage and the maximum tube current allowed to flow at the nominal maximum tube voltage		125kV、100mA	
	The maximum tube current and the maximum tube voltage that allows the maximum tube current to flow		160mA、 80kV	
	The combination of the tube voltage and tube current that output the maximum electrical power		125kV、100mA 100kV、125mA 80kV、160mA	
	The minimum value of the current time product		0.32mAs	
	The maximum value of the current time product		320mAs	320mAs
	The minimum value of nominal irradiation time		3.2ms	
The current time product that can be set with the X-ray tube voltage		40～90kV	0.32～320mAs	0.32～320mAs
		91～100kV	0.32～280mAs	0.32～280mAs
		101～110kV	0.32～250mAs	0.32～250mAs
		111～120kV	0.32～220mAs	0.32～220mAs
		121～125kV	0.32～200mAs	0.32～200mAs
Setting and display of tube voltage for exposure		Range of the setting:	40～125kV、in 1-kV increments	
		Display:	Digital display	
Accuracy		X-ray tube voltage	Less than 10%	
Setting and display of radiographic current time product.		Range of the setting:	0.32, 0.36, 0.40, 0.45, 0.50, 0.56, 0.63, 0.71, 0.80, 0.90, 1.0, 1.1, 1.2, 1.4, 1.6, 1.8, 2.0, 2.2, 2.5, 2.8, 3.2, 3.6, 4.0, 4.5, 5.0, 5.6, 6.3, 7.1, 8.0, 9.0, 10, 11, 12, 14, 16, 18, 20, 22, 25, 28, 32, 36, 40, 45, 50, 56, 63, 71, 80, 90, 100, 110, 125, 140, 160, 180, 200, 220, 250, 280, 320mAs The maximum value is 200 mAs with MUX-100HJE.	
		Display:	Digital display	

Accuracy	X-ray tube current time product	Less than 10%+0.2mAs
Anatomical program		Up to 72 kinds of anatomical programs can be stored. (72 kinds = 8 body parts × 3 orientations × 3 body thickness) The contents of anatomical program stored in memory are: (a) Exposure condition (kV, mAs) (b) Method of exposure
Direct APR setting		Anatomical program setting is available in combination with communication with CXDI Software

		MUX-100D	MUX-100DJ
Collimator		R-20C	
Field	Shape	Rectangular	
	Max. field	430 × 430 mm SID 1m	
	Min. field	0 × 0mm (leaves overlapped)	
Light field	Average illumination	> 160 lx	
	Contrast ratio of edge	> 3	
	Accuracy	2% of SID	
	Display of center	Cross lines	
	Type of lamp	Halogen lamp (12V, 100W), #55939	
	Illuminating period	30 seconds, with automatic turn-off time switch	
Field size indication	SID indicated	1, 1.5, 2 m	
	Dimensions indicated	20(8), 23(9), 25(10), 28(11), 30(12), 36(14), 43(17) cm(in.)	
	Accuracy of SID indication	5%	
Drive of leaves		manual	
Mounting dimension (Focus to fit surface distance)		56 mm	
External dimension (W × D × H)		202 × 211 × 197 mm	

X-ray tube Assembly*

Model Name		0.7U163CS-36
Spot size		0.7mm
Target angle		16deg
Nominal X-ray tube Voltage	Radiography	125kV
X-ray tube Assembly	Max. Heat	750kJ(1060kHU)
	Max. Continuous heat dissipation rate	120W(170HU/s)

X-ray Tube	Max. Anode heat dissipation rate	212kJ(300kHU)	
	Max. Anode heat dissipation rate	800W(1130HU/s)	
	Max. Continuous heat dissipation rate	210W(300HU/s)	
	Weight	13kg	

Battery

Type	Small sized value regulated lead-acid battery
Specification	12V
Quantity	20 pieces

Minimum specific filtration

Total	2.5 mm Al 70 kV
X-ray tube assembly	Equivalent to 1.5 mm Al 70 kV
Multi-leaf collimator	Equivalent to 1.0 mm Al 70 kV

Classification of the system

Method of protection against electric shock	Class Ⅰ (only during charging) Internal powered (during powered by internal battery)
Degree of protection against electric shock	Type-B
Classification according to operation mode	Continuous operation with intermittent load

*For detail about X-ray-tube assembly, please refer to X-ray tube operation manual (M535-E219).

Options	MUX-100D	MUX-100DJ
Remote controller	Infrared type Ready operation, X-ray operation, Collimator lamp ON/OFF	
Removable X-ray protective screen	Removable X-ray protective acrylic screen	
Dose Area Meter	Indicates the dose area.	
Grid	Refer to CXDI manual	

NOTE: Special option can not be changed after the equipment being shipped.

CXDI-50G

CXDI-50G is containing mainly three componets;

- Imaging unit; Digital Cassette that has the mobility and can be used on the optional angles
- Power box; Power supply and data gateway for imaging unit mounted in the MUX-100D.
- CXDI ; Digital Radiography Operation System for CXDI-50G, installed in Control PC and controled with Touch panel monitor on the MUX-100D.

(1) Imaging Unit

The sensor unit converts the X-ray image to the electrical signal (O/E Conversion) and after performs the A/D conversion, transfer its signal through the Power Box with Ethernet cable to the Control PC.

Imaging unit	
Effective range	353 x 430 mm
Number of Pixels	2214 x 2700
Effective Number of Pixels	2208 x2688
Pixel Pitch	160μm x 160μm
Fluorescent substance	GOS Fluorescent screen
Imaging Unit mass	4.8kg (except Grid)
Mechanical strength	Load uniformly: 150kg Load partly: 100kg/ϕ40mm
Mass	4.8 kg (Except cable)
Attenuation equivalent of front panel	0.2mmAl.Eq.
Dimension	491(W) x 477(D) x 23(H)mm with operation grip
Power Box	
Communication interface standard	IEEEE 802.3u (100BASE-TX) Connector type: RJ45
Dimension	358(W) x 200(D) x 65(H)mm
CXDI	
Image field sensing	Automatic field sensing
Grayscale	12bit (4,096 grayscale)
Preview image access time	Approx. 3 second
Data output	DICOM 3.0 compatible, Print Management Service Class (SCU), Storage Service Class (SCU) (JPEG transfer syntax available)
Storage	Temporary storage in Hard disk of the Control PC
Option	
Grid	Attenuation equivalent:2.3mmAl.Eq.

For detail about CXDI, please refer to CXDI series operation manual (Canon CXDI Digital Radiography).

1-3 System Drawing

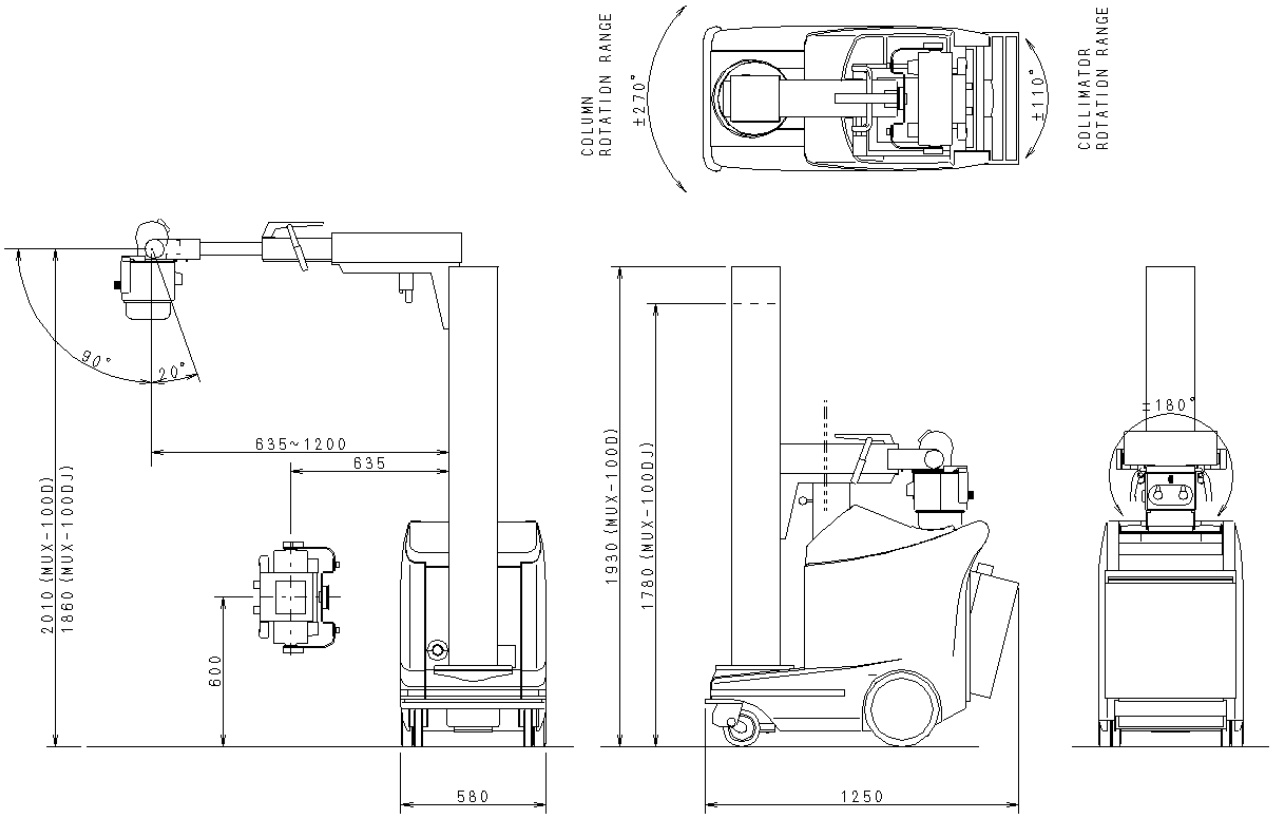


Fig.1-1 Dimensional drawing of the system

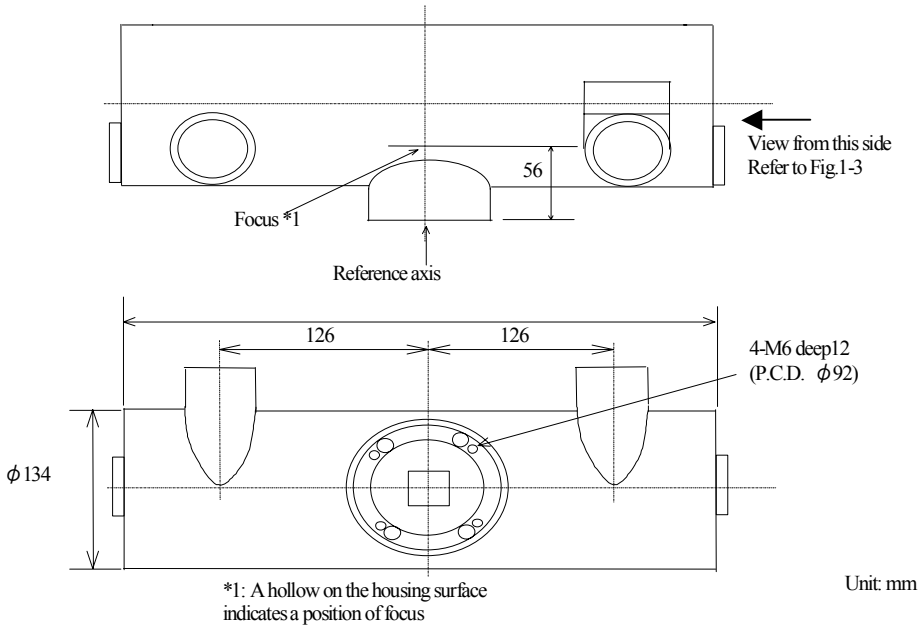


Fig. 1-2 X-ray reference axis and focal spot position (front and upper view)

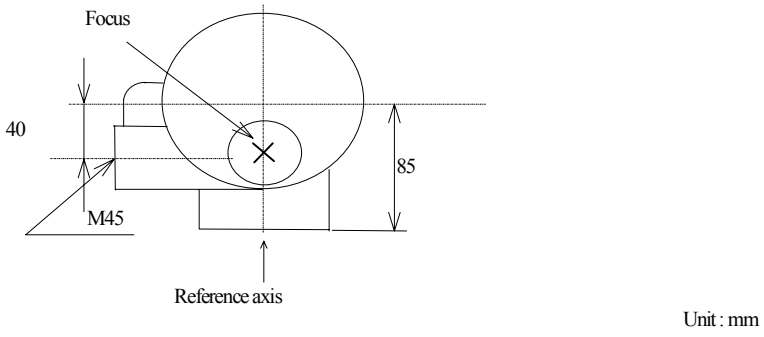
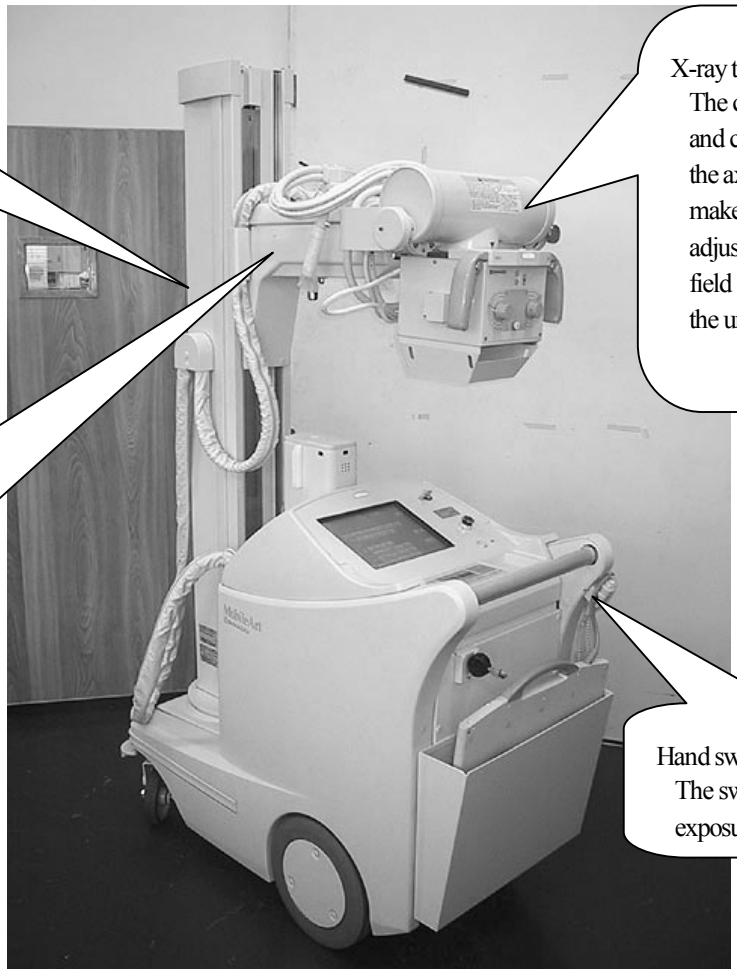


Fig. 1-3 X-ray reference axis and focal spot position (Side view)

1-4 Name of Each Part

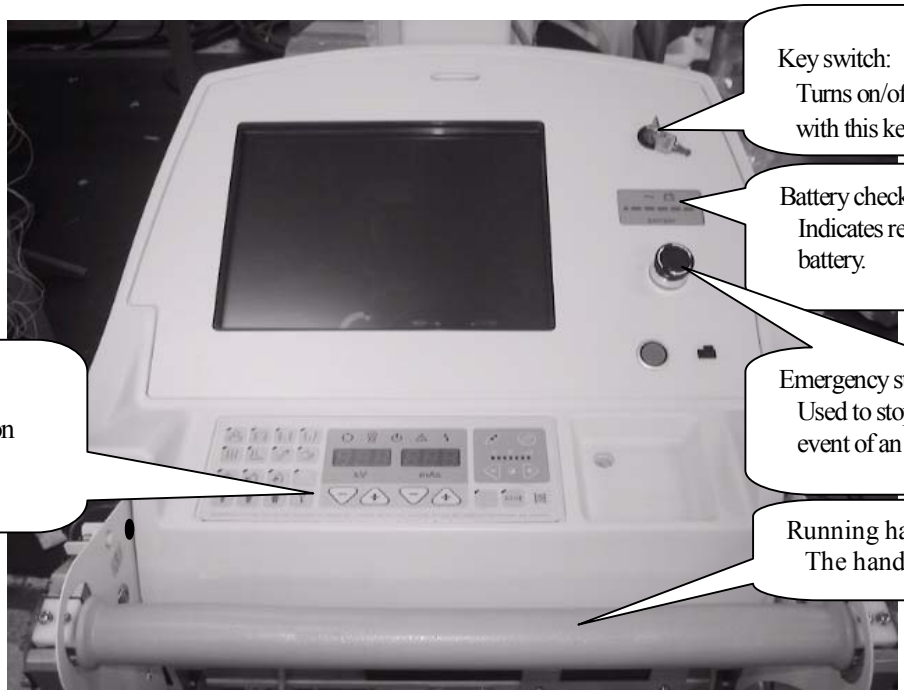


Support Stand:
Holds the tube section and arm. It can turns itself.

X-ray tube unit:
The combination of X-ray tube and collimator can turn around the axis of X-ray focus. This makes positioning and adjustment of the irradiation field and small movement of the unit.

Arm section:
Holds the tube section. It can slide vertically on the support stand and the arm itself can stretch in the horizontal direction.

Hand switch:
The switch to make X-ray exposures



Key switch:
Turns on/off power for the unit with this key operation.

Battery checker:
Indicates remaining charge of the battery.

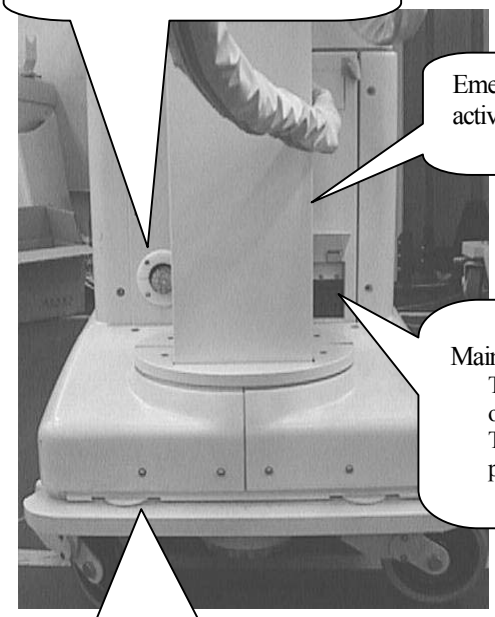
X-ray control panel:
Refer to Operation Manual

Emergency stop switch:
Used to stop the motor in the event of an emergency.

Running handle:
The handle to drive the unit·

Switch for activating the emergency brake release function:
In the trouble of the running system, the brake release function for the emergency is put into the state which can be operated by the key operation.

Power plug:
Used to charge the battery.



Emergency brake active key switch:

Main circuit breaker:
Turning off this breaker cuts off power for the whole unit. The lid can be opened by pressing and releasing it.

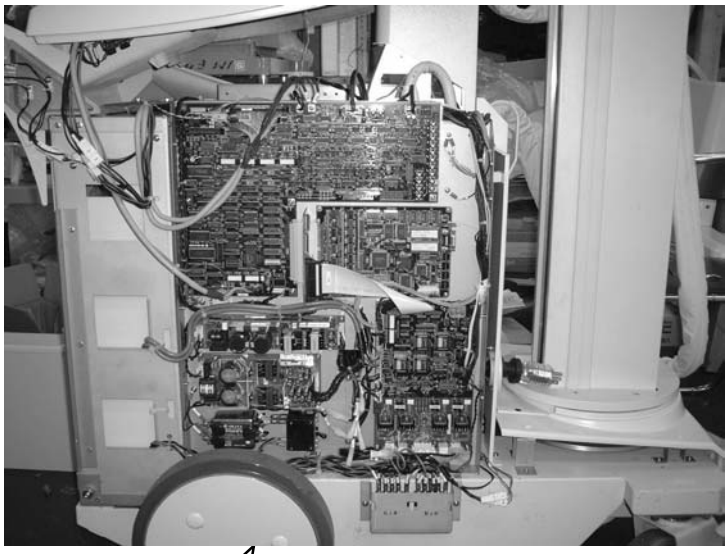
Bumper switch section:
Stops the unit in the event of a collision.

2-1 Tools Required in Maintenance

For installation or maintenance of the system, prepare the following tools:

- ☐ Screwdriver (Phillips head type/normal head type)
- ☐ Hexagon wrenches Nos. 2.5 to 10
- ☐ Nipper
- ☐ Cutting pliers
- ☐ Tester (digital)
- ☐ Alligator clip
- ☐ Cable tie
- ☐ Cutter
- ☐ Grease
- ☐ Waste
- ☐ Alcohol or acetone for cleaning
- ☐ Bolt M8,M12×16 cm (for replacing the tube)
- ☐ Oscilloscope
- ☐ Wrench for FU lock nut AW04
- ☐ Spring scale (for adjusting the handle 0 ~ 20 kg)

2-2 Layout of Each PCB



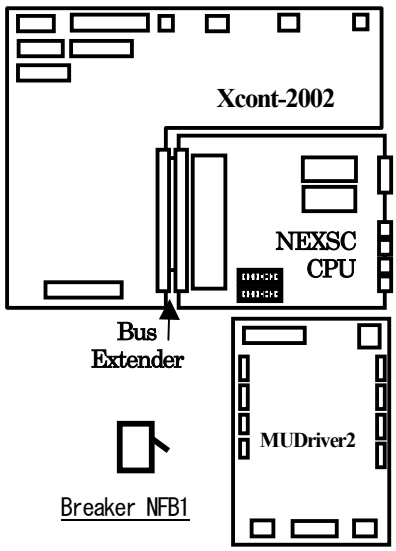


Fig. 2-1 Control Unit (Right Side)

No-fuse breaker
(lower position: ON)

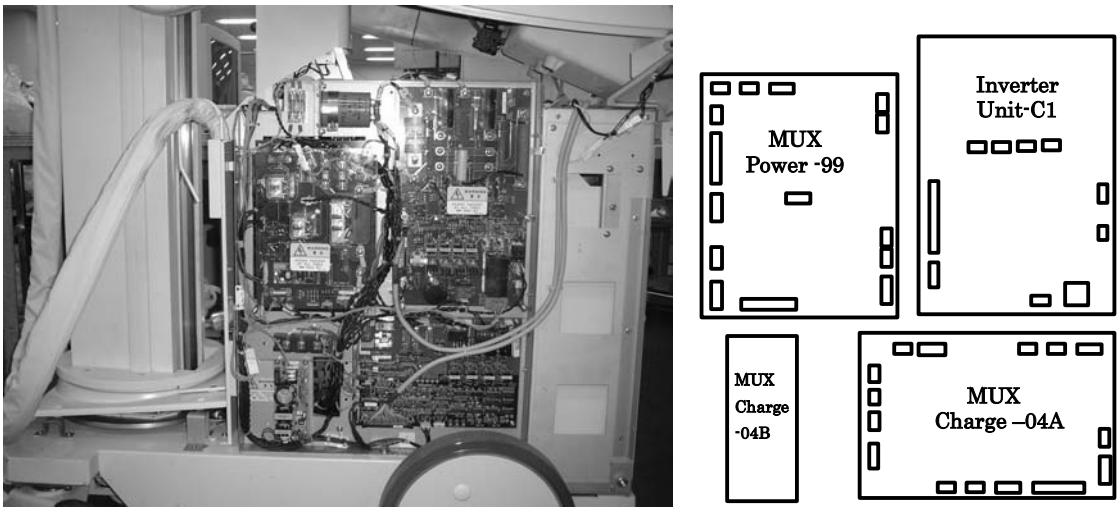


Fig. 2-2 Control Unit (Left Side)

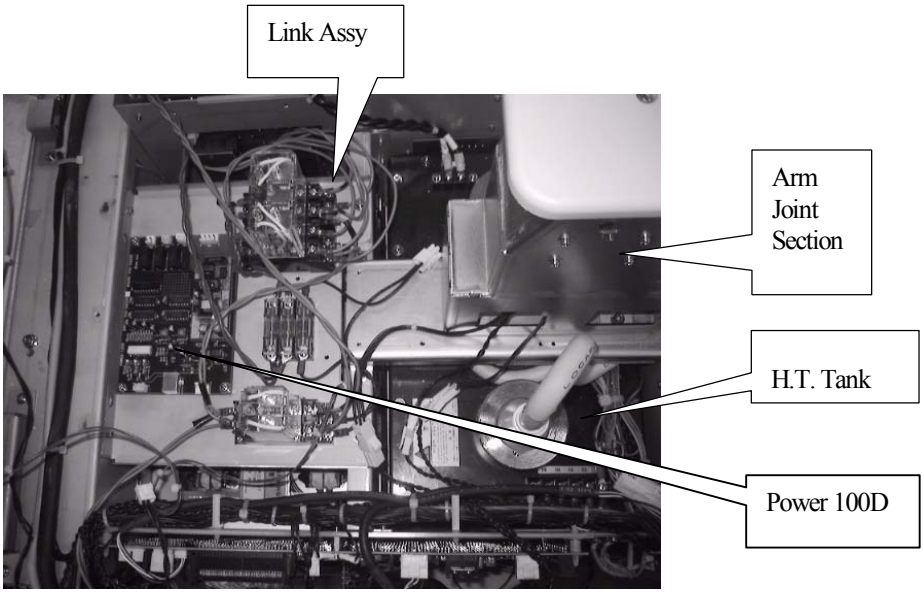


Fig.2-3 Link Assy (Top of the batteries)

2-3 Outline of Each PCB

X CONT 2002 PCB

- ☐ Controls the operation panel.
- ☐ Offers diversified I/Os.
- ☐ Performs D/A and A/D conversion.
- ☐ Detects and controls the tube voltage, and detects discharge of the X-ray tube.
- ☐ Detects and controls the tube current (control through filament heating).
- ☐ Detects the tube current.
- ☐ Interfaces each PCB.

MUX CHARGE-04A PCB

- ☐ Detects the battery voltage and charged voltage error.
- ☐ Controls the battery charging current, and detects charging current error.
- ☐ Offers the inverter circuit for the starter and the collimator lamp.

MUX CHARGE-04B PCB

- ☐ Offers the inverter circuit for battery charging.
- ☐ Detects the battery charging current.

MUX-LC1B PCB

- ☐ Noise Filter for the power supply of MUX CHARGE-04B PCB.

MUX POWER-99 PCB

- ☐ Turns on and off the power, and offers the automatic power OFF function.
- ☐ Supplies the power from the batteries to each part.
- ☐ Change over AC and DC of the DC pack input.
- ☐ Detects the battery voltage.

INVERTER UNIT- C1 PCB

- ☐ Offers the main inverter.
- ☐ Offers the inverter circuit for heating the filament.
- ☐ Controls the starter. Detects the stator coil current.

MU DRIVER-2 PCB

- ☐ Controls the DC motors.
- ☐ Detects the handle operation.
- ☐ Detects the bumper switch.
- ☐ Controls the arm catch area.
- ☐ Controls the electromagnetic lock.
- ☐ Detects the Stop switch.
- ☐ Detects the Emergency Brake Release switch

NEXSC PCB

- ☐ CPU

BUS EXTENDER PCB

- ☐ Extends the NEXSC bus.

SHEET PANEL MUX-B PCB

☐ Sheet panel for Key Switch Panel Assy.

SHEET PANEL MUX-100D PCB

☐ Main Sheet panel to operate X-ray generator.

POWER-100D PCB

☐ Controls the power supply for DR system (CANON FPD).

RC TRANSMITTER PCB (option)

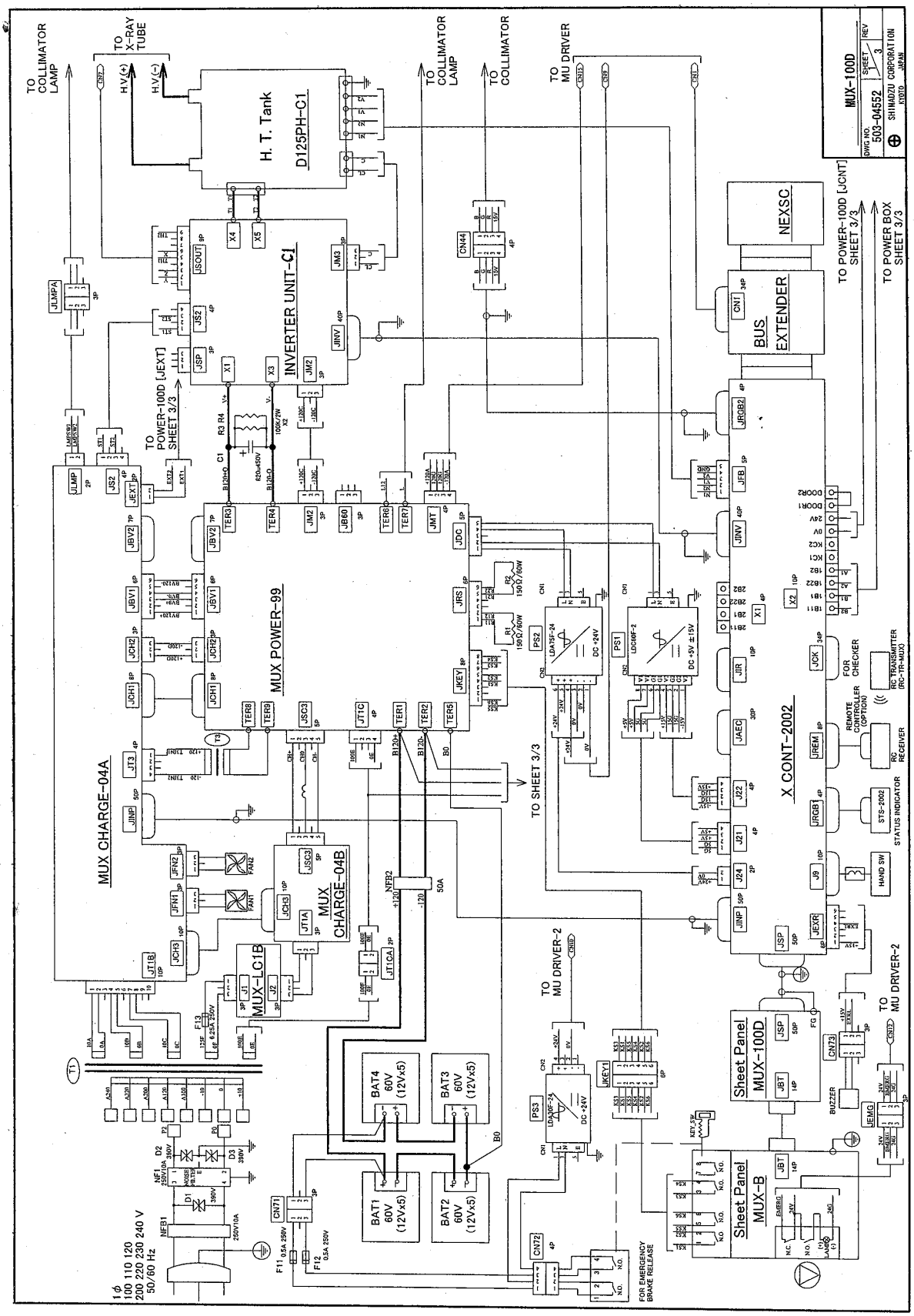
☐ Controls send for remote control.

RC RECEIVER PCB (option)

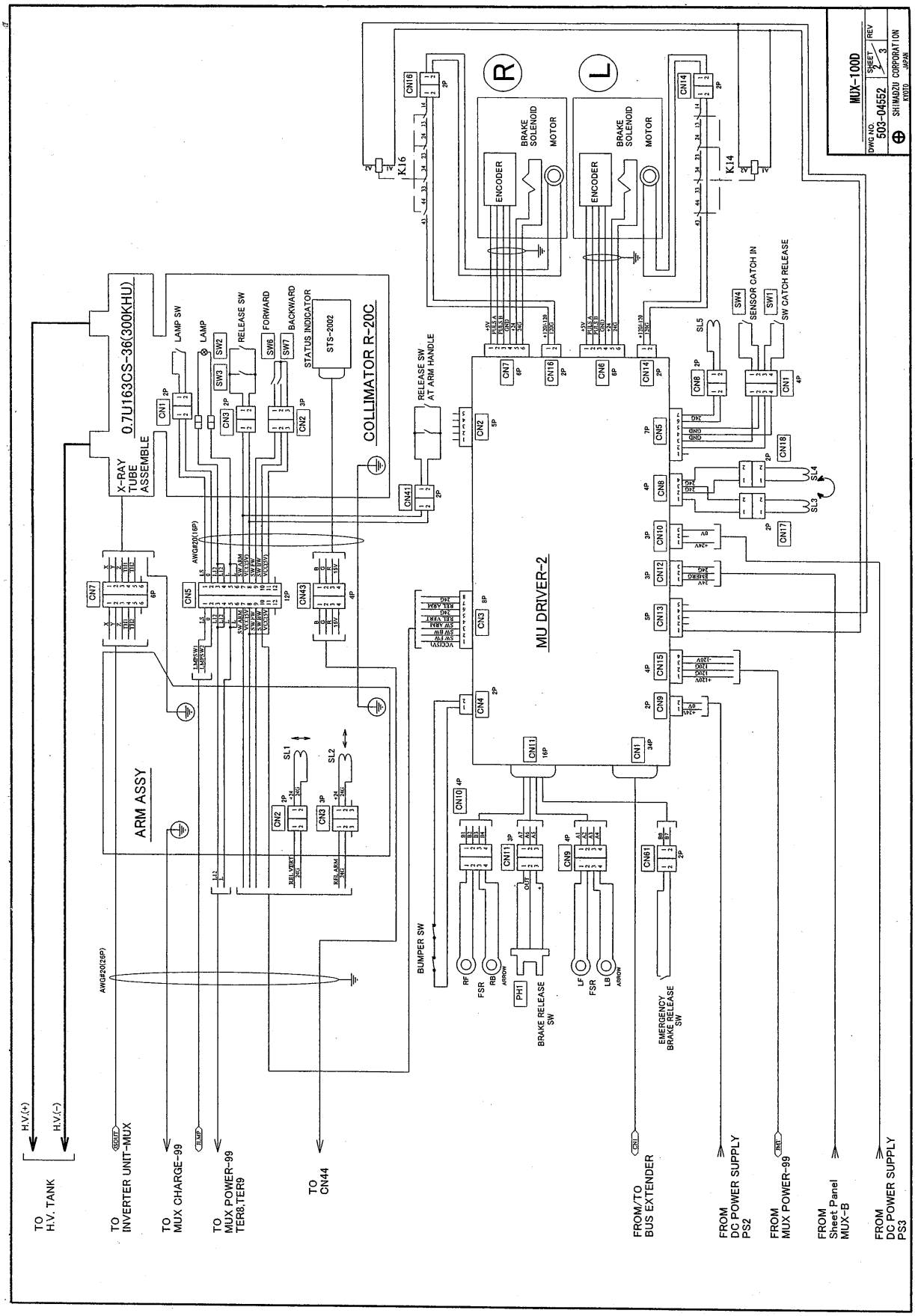
☐ Controls receive for remote control.

3-1 Total connection diagram

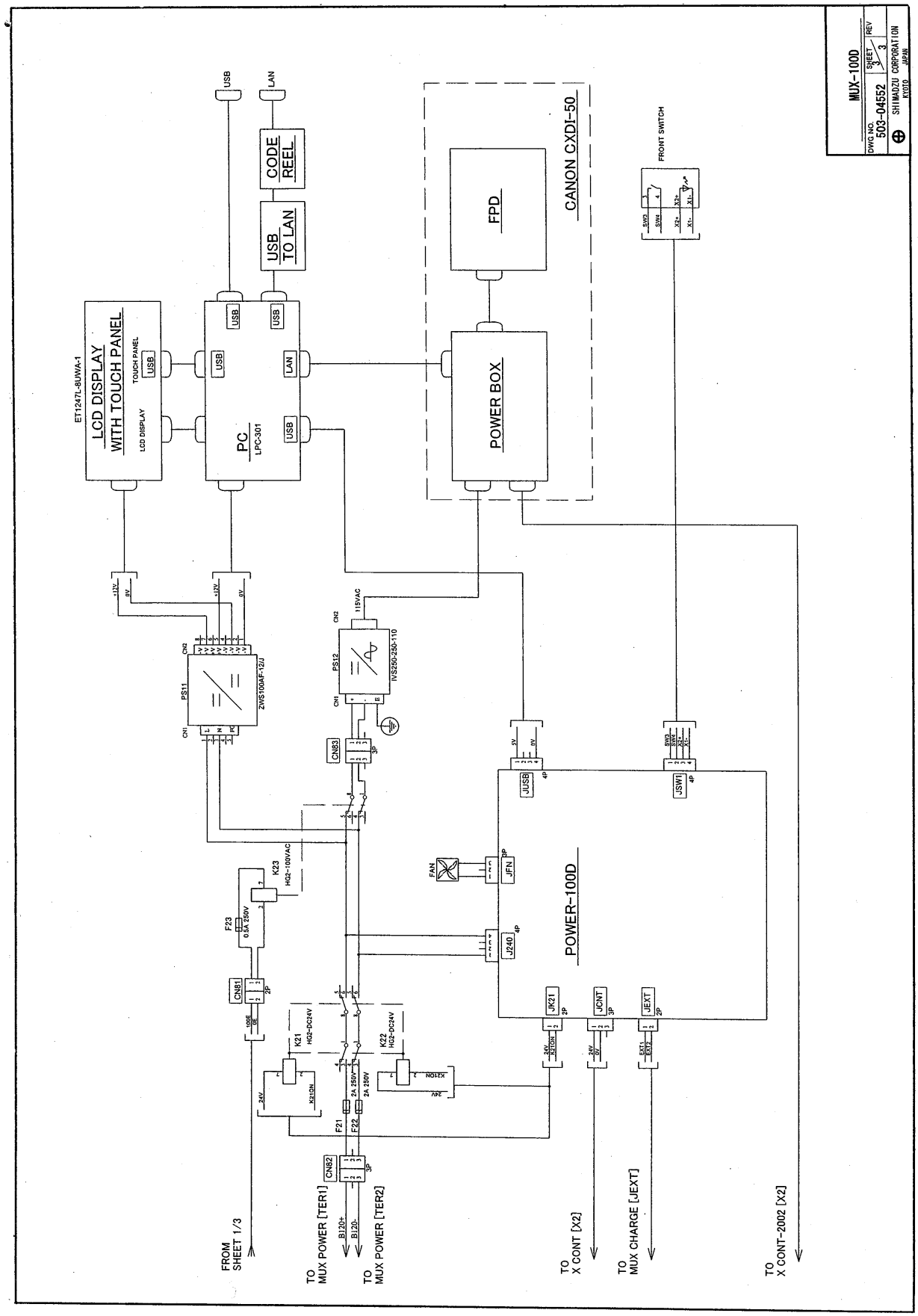
SHEET 1



SHEET 2


MUX-100D
DWG NO. 503-04552
SHEET 3
REV
SHIMADZU CORPORATION
KYOTO JAPAN
MU DRIVER-2
COLLIMATOR R-20C
0.7U163CS-36(300KHU)
X-RAY TUBE ASSEMBLE
ARM ASSY
ENCODER
BRAKE SOLENOID
MOTOR
LAMP SW
LAMP
RELEASE SW
FORWARD
BACKWARD
STATUS INDICATOR
STS-2002
RELEASE SW AT ARM HANDLE
SENSOR CATCH IN
SW CATCH RELEASE
BUMPER SW
BRAKE RELEASE SW
EMERGENCY BRAKE RELEASE SW
TO H.V. TANK
TO INVERTER UNIT-MUX
TO MUX CHARGE-99
TO MUX POWER-99 TER8,TER9
TO CN44
FROM/TO BUS EXTENDER
FROM DC POWER SUPPLY PS2
FROM MUX POWER-99
FROM Sheet Panel MUX-B
FROM DC POWER SUPPLY PS3

SHEET 3


MUX-100D
DWG.NO. 503-04552
SHEET 3
REV
SHIMADZU CORPORATION KYOTO JAPAN
USB
LAN
CODE REEL
USB TO LAN
CANON CXDI-50
FPD
POWER BOX
FRONT SWITCH
LCD DISPLAY WITH TOUCH PANEL
ET1247L-8UWA-1
TOUCH PANEL
LCD DISPLAY
PC
LPC-301
ZWS100AF-12/J
IVS250-256-110
115VAC
POWER-100D
FAN
JFN
J240
JUSB
JSW1
JK21
JCNT
JEXT
K21
K22
K23
HG2-DC24V
HG2-100VAC
F21
F22
F23
0.5A 250V
2A 250V
CN81
CN82
CN83
FROM SHEET 1/3
TO MUX POWER [TER1]
TO MUX POWER [TER2]
TO X CONT [X2]
TO MUX CHARGE [JEXT]
TO X CONT-2002 [X2]

3-2 Basic Operation of Each Part

3-2-1 Power ON/OFF operation

Related PCB: MUX POWER PCB

Ⅰ Power ON operation

i When the key switch is set to ON, all of four contacts of the key switch are closed.
It means that all of three contacts of the connector JKEY on MUX POWER PCB are closed.
(Another one more contact of the key switch is used for Power On/Off circuit of DR system.
Refer to 3-2-7.)

ii The battery voltage 240 VDC is input to PS1 on MUX POWER PCB, and 12V is output.

iii The latch relay K9 turns ON, and the relay K6 turns ON.

iv As a result, the power is supplied to each part via the current restraining resistors R1 and R2 (150Ω) in the control unit and the connector JRS.

v Because the power is supplied to the DC pack PS1 and PS2 through the connector JDC, 5V, 15V and 24V are output and the control PCBs starts to operate.

vi After check by the NEXSC (CPU) PCB is completed (in approximately 1 to 2 seconds), the MGRS signal is sent to the XCONT PCB and the MUX CHARGE-04A PCB to turn ON the relay K4.
As a result, the relay K7 turns ON, the route through the R1 and the R2 in the control unit is short-circuited, and sufficient load current can flow.

vii When the MGRS signal is output, the system becomes ready for operation.

(Reference) The ON status of the key switch (the KEYSW signal) is transmitted to the XCONT PCB via the MUX CHARGE-04A PCB, then it is recognized by CPU as the fact that the KEYSW1 line and the KEWSW2 line are short-circuited.

Ⅱ Power OFF operation

i When the key switch is set to OFF, the relay K7 turns OFF first. Though the input to the PS1 in the DC pack stops, the output remains for a while. Accordingly, the relay K6 turns OFF after a while. By this operation, the power supplied through the resistors R1 and R2 remains for a while because excessive load is applied on contacts if all contacts are opened at the same time.

Ⅲ Auto power OFF operation

i In the power ON status, the CPU outputs the AUTOOFF signal through XCONT and MUX CHARGE-04A PCBs to set the relay K5 to ON. As a result, the latch relay K9 turns OFF, the relays K6 and K7 turn OFF, the power supplied to the DC pack stops, then the system stops.

ii In this status, PS1 on MUX POWER PCB is continuing operation. Accordingly, if the system is left in the auto power OFF status, the batteries are discharged in a long period due to the fine discharge current.

3-2-2 Operation when power plug is connected (changeover between AC and DC of DC pack input)

Related PCB: MUX POWER PCB

i When the power plug is connected, the 100V output (100E-0E) of the transformer T1 is input to the MUX POWER via the connector JT1C.
ii The relay K1 turns ON, and the power supply line to the DC pack is changed over from the battery power to the 100 VAC.
iii 100 VAC is supplied to the DC pack, 5V, 15V and 24V are output from the DC pack, and the control PCB starts to operate.
iv At the same time with ii, the relays K3 and K2 turn ON. When the K3 turns ON, connection of the relays K6 and K7 to the coil is shut down, and the batteries are isolated from all loads.
v When the relay K2 turns ON, the ACON1 and the ACON2 are short-circuited, connection of the power plug is transmitted (as the LVON signal) to the XCONT PCB via the MUX CHARGE-04A PCB, then the CPU recognizes connection of the power plug.

(Reference) Based on the lesson learn from the MC125L-50, all loads are isolated while the batteries are charged. The used DC pack is the 110-330 VDC/90-264 VAC input type.

3-2-3 Detection of battery voltage

Related PCBs: MUX POWER PCB and MUX CHARGE-04A PCB

Ⅰ Explanation

i Twenty batteries are connected in series, 10 batteries on the pulse side and 10 batteries on the minus side.
The middle point is connected to the chassis via resistors of several MΩ (on the MUX POWER, MUX CHARGE-04A and MU DRIVER PCBs).
ii The plus, the minus and the middle point of the batteries are offered at the following terminals on the MUX POWER PCB.

Battery plus side : TER1 [B120+]
Battery middle point : TER5 [B0]
Battery minus side : TER2 [B120-]

iii The values at the terminals above are converted into the battery voltage detection value (“120+” signal at CP10 and “120-” signal at CP11) on the MUX CHARGE-04A PCB via the resistors R8 to R11 (10 MΩ) and the connector JBV1.
The relationship between the actual battery voltage and the detection value (“120+” and “120-” signals) is approximately “3V/100V”. For example, when the actual battery voltage is 120V, the detection value at CP10 or CP11 is about 3.6V.
iv Finally, the “120+” and “120-” signals are sent as the VP1 and the VP2 to the XCONT PCB.

Ⅱ Battery Charged Voltage Over

i The “120+” and “120-” signals are checked for the error Charged Voltage Over by the operation amplifier A8.
The threshold is 4.67V.
It is equal to 156V (= 4.67 × 100/3) as the actual battery voltage (on both plus and minus sides).
ii The detection result is sent as the error signal CHBR2 to the XCONT PCB, then charging stops.

(Reference) The connectors JB60 and JBV2 on the MUX POWER PCB are not used.

3-2-4 Charging circuit

Related PCB: MUX POWER PCB, MUX CHARGE-04A/04B PCB

I Charging

i When the power plug is connected, the 125V (125F-0F) output of the transformer T1 is input to the connector JT1A on the MUX CHARGE-04B PCB.

ii The above mentioned 125V is rectified and charged on the capacitor C6,then this charged voltage on C6 (about 177±20V) is connected to the inverter circuit on the MUX CHARGE-04B PCB.
The output of this inverter circuit is connected to the battery via the connector JSC3 on the MUX POWER PCB.

iii This inverter circuit on the MUX CHARGE-04B PCB is controlled by the driving signal Q14C/Q23C from MUX POWER-04A PCB via the connector JCH3.
The MUX CHARGE-04A PCB controls the inverter by PWM method while comparing the measured charging current IC1 (CP9:1V/1A) with the preset charging current PIC (CP25:1V/1A).
The measured charging current is detected by the current transformer CT1 on the MUX CHARGE-04B PCB .

iv The preset charging current PIC is controlled as the following table depending on the current charged voltage of the battery.

Beginning of charging	Charging starts with PIC 0.5A.. If the charged voltage doesn't reach to 280V within 5 min., proceeds to STEP 1. If the charged voltage reaches to 280V within 5 min., proceeds to STEP 3.
STEP 1	PIC is 2.0A. Proceeds to STEP 2 when the charged voltage reaches to 280V.
STEP 2	PIC is 1.0A. Proceeds to STEP 3 when the charged voltage reaches to 285V.
STEP 3	PIC is 0.4A. Proceeds to STEP 4 when the charged voltage reaches to 290V.
STEP 4	PIC is 0.18A. Charging finishes when the charged voltage reaches to 290V.

Table 3.1 STEP of PIC

As well, there are two kinds of switching frequency of the inverter for battery charging depending on the preset charging current PIC as shown on the below table.

PIC	Frequency of the inverter
2.0A	13kHz
1.0A	
0.4A	2kHz
0.18A	

Table 3.2 Frequency of the inverter for battery charging

v The signal CHON from the XCONT PCB is required to start control of the inverter.
If the key switch is set to OFF and DR system is turned OFF , CHON and PIC will be available when the power plug is connected, regardless of the current battery charged voltage.
When the key switch is set to ON or DR system is turned ON, battery charging is prohibited to prevent the fuse blow because charging current with high frequency will flow into the filter inside DC power supply (switching regulator) as shown below.

When the key switch is set to ON. >>> The DC power supply PS1 on MUX POWER PCB is connected to the battery.
When DR system is ON. >>> DC/AC converter PS12 for POWER BOX of DR system (CXDI-50G) and DC12V power supply PS11 for PC and LCD are connected to the battery.

(In case of MUX-100/100H, the battery charging doesn't start if the current battery voltage is high. As well, the ON/OFF status of the key switch is not related to the charging.)
The green LED LD1 on MUX CHARGE-04A will light on when CHON is available.

II Charging Current Over

i When the measured charging current exceeds approximately 3.2A, the error Charging Current Over is detected by the operation amplifier A5B.
ii The detection result is sent as the error signal CHBR1 to the XCONT PCB, then charging stops.

3-2-5 Inverter circuit for starter and lamp

Related PCB: MUX CHARGE-04A PCB, INVERTER UNIT PCB and transformer T3

I Explanation

i For the starter and the lamp, a common inverter (60 Hz) is mounted on the MUX CHARGE-04A PCB.
ii The input voltage is the battery voltage (approximately 240V). The pulse width is adjusted, and converted into the AC with a duty ratio proper to the starter and the lamp.
The pulse width for the starter is adjusted by VR2, and the pulse width for the lamp is adjusted by VR1 on the MUX CHARGE-04A PCB.
iii The relay K2 changes over the destination of the inverter output between the starter and the lamp.
iv Though the control signals LAMPON and STON are sent from the XCONT PCB, rigid attention should be paid because the names do not correspond to the actual contents. LAMPON = Inverter operation ON signal. STON = Relay K2 changeover signal. While the starter is operating, the LAMPON signal is ON and the STON signal is OFF. While the lamp is lit, the LAMPON signal is ON and the STON signal is ON.
v Rough explanation of the inverter operation is as follows: The basic frequency of 120 Hz is generated at CP16 on the MUX CHARGE-04A PCB . The M12 forms the frequency into the pulse width proper to the starter and the lamp. Because the frequency is as low as approximately 100 Hz, it cannot goes through the pulse transformer which is isolated the FET. To cope with this, the frequency of 50 Hz is added, and the basic frequency is converted into a waveform which can go through the pulse transformer.

(Reference) Because the inverter output is as high as 240V and not proper to be supplied to the lamp, it is reduced to a proper voltage by the transformer T3.

3-2-6 Main inverter unit, filament heating inverter unit and starter circuit

Related PCB: INVERTER UNIT PCB

Ⅰ Main inverter unit

i This inverter unit generates high voltage, and is equipped with the IGBT and the gate drive circuit. The gate drive signal comes from the XCONT PCB.

Ⅱ Filament heating inverter unit

i This inverter unit heats the filament, and is equipped with the FET and the gate drive circuit.
The gate drive signal comes from the XCONT PCB.
Besides the inverter, a part of the primary current detection unit is mounted also.(The current transformer CT1 etc.)

(Reference) Because a part of the current detection unit is mounted, it is required to confirm adjustment of the FVR value (preset value of filament current) if the entire INVERTER PCB is replaced for replacement of the IGBT.

Ⅲ Starter circuit

i The starter power is turned on/off by the inverter on the MUX CHARGE-04B PCB.
The starter circuit on INVERTER UNIT PCB detects the stator coil current and inserts a phase advancing capacitor.

(Reference) In case of MUX-100 series including MUX-100D/100H series, if the dip switch SW1-1 on INVERTER UNIT PCB is ON, the STON signal may not be able to turn ON due to the interference with the SSR Q10.
So, SW1-1 should be set to OFF("MUX-100" side).

3-2-7 Power ON/OFF circuit for DR system

Related PCB: Power 100D PCB and Link Assy

Ⅰ Power Supply for Power 100D PCB

i DC24V is input to the connector JCNT of Power 100D PCB from XCONT PCB when the key switch is set to ON and XCONT PCB is working.

ii DC5V is obtained as output of the regulator M7 from DC24V.
Power 100D PCB starts function with this DC5V power supply.

Ⅱ ON operation of DR system

i When the switch "DR" is pressed, the operation signal is input to PC1A through the connector JSW1 of Power 100D PCB. Then, M1A generates high level pulse for 2.5 sec.
There is no input signal from the connector JUSB because PC is not ON for this moment.
As a result, M4A③ becomes high level for 2.5 sec.

ii M4B⑥ also becomes high level if DC24V input is available from XCONT PCB through JCNT.
As a result, the output of M1B also becomes high level for 6 sec.
This signal is input to M3, then the relays K1,K2,K3 turn ON.

iii As K1 turns ON, the relays K21 and K22 of Link Assy also turn ON. (K21 and K22 are connected to the connector JK21.)
As a result, the battery voltage is supplied to PS11 (DC 12V power supply for PC and LCD) and PS12 (DC/AC inverter for CANON Power Box) ,then the power of DR system becomes ON.
At the same time, M6 generates DC24V since the battery voltage is supplied through J240.
As well, the fan ,which is located near from PC and is connected to JFN ,starts working.

iv As K2 turns ON, the contact of JEXT is closed.
This signal goes to JEXT on MUX CHARGE-04A, then goes to XCONT PCB.
Finally, it reaches to NEXSC PCB, then CPU can recognize that DR system is ON.

v As K3 turns ON, LED in the switch "DR" lights ON.

vi LED5 on Power 100D PCB lights ON.

vii If PC becomes ON within 2.5 sec. after the switch "DR" is pressed , DC5V is input from USB port of PC through the connector JUSB, then M5B⑥ becomes high level.
As a result, the input of M3 is still at high level even after M1B⑤ returns to low level.
Namely, the power of DR system is kept on ON condition.

If the key switch of MUX-100D is set to OFF, DC24V is not supplied from XCONT PCB.
However, DC24V still exists as the output of DC power supply M6 because J240 is connected to the battery.
As well, DC5V also still exists as the output of the regulator M7.
So, Power 100D PCB can continue working.
Namely, DR system can keep ON condition even if the key switch is set to OFF under ON condition of DR system.

Ⅲ OFF operation of DR system

When PC is shut down by SHUT DOWN operation from DR system, DC5V from USB port of PC disappears, then the input signal to M3 becomes low level.
As a result, all of K1,K2,K3 on Power 100D PCB and also K21,K22 of Link Assy turn off, then power supply for DR system is shut down.
At the same time, the power supply to J240 also disappears, then Power 100D PCB stops working.

4-1 Environmental Condition

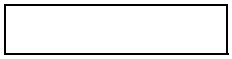
Before installation, confirm the environmental condition below first.
Required environmental condition for MUX-100D is shown below.
DR system CXDI-50G (including the Flat Panel detector) has the different requirement.
(Refer to Operation Manual of CXDI-50G.)
But, CXDI-50G has wider acceptable range of environmental condition than MUX-100D.

Use environment

Ambient temperature	:	10°C - 35°C
Relative humidity	:	30% - 75% (no dew condensation)
Atmospheric pressure	:	700 hPa - 1060 hPa

Storage environment (not for transport and storage before delivery)

Ambient temperature	:	10°C - 35°C
Relative humidity	:	30% - 75% (no dew condensation)
Atmospheric pressure	:	700 hPa - 1060 hPa



Charge the battery in the use environment.
Do not charge in the storage environment.

Power supply

AC power

System	:	Single phase AC
Frequency	:	50/60 Hz
Standard voltages	:	100, 110, 120, 200, 220, 230, 240 V (set one of the voltages when installing)
Voltage variation range	:	±10% of standard voltages
Supply capacity	:	1kVA
Power Supply Impedance	:	100, 110, 120 V : No more than 1.0Ω 200, 220, 230, 240 V : No more than 4.0Ω

Earth

Earth terminal	:	Earth resistance of no more than 100Ω
Additional earth terminal	:	Earth resistance of no more than 100Ω

4-2 Installation Procedure

4-2-1 Flow chart in installation procedure

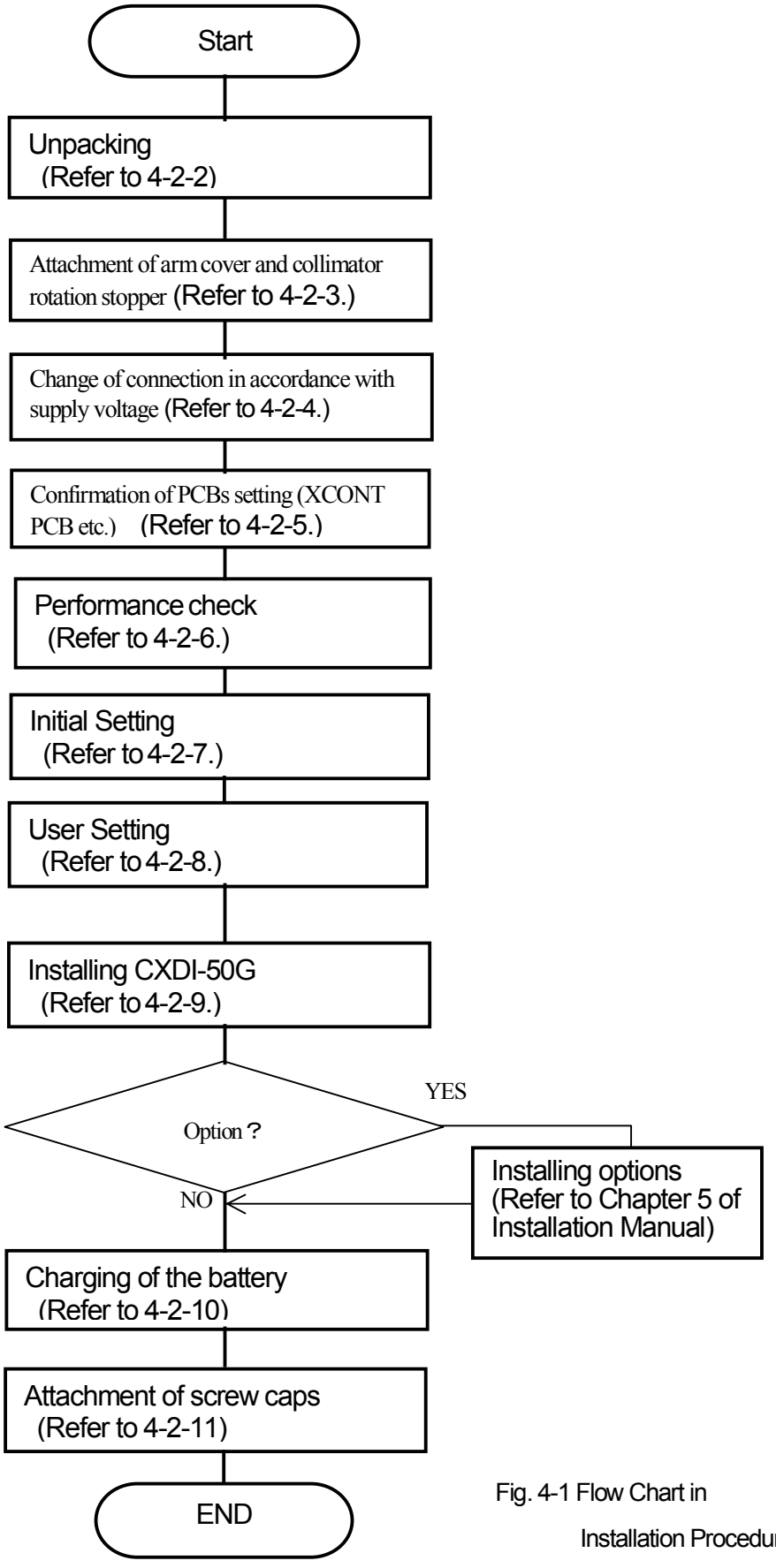


Fig. 4-1 Flow Chart in Installation Procedure

4-2-2 Unpacking

At first, confirm that the following items are contained in the package.

Name	Name	P/N	Q'ty	Remarks
MUX main unit	MUX-100D(CE)	503-61000-02	1	
	MUX-100D(ETL)	503-61000-03	1	
Components	Arm cover	503-51342 503-51344	1	Mounting screws are provided on arm in main unit.
	Repair parts	502-21566 037-61103	1 1	46 pieces of caps (5 spare caps are included.) Caps
	Operation manual	M503-E017	1	
	Installation manual	M503-E320	1	

After removing packing materials, set to ON the main breaker (Refer to "1-4 Name of Each Part".), then set to ON the key switch (Refer to "1-4 Name of Each Part".) to turn on the power of the system.
After that, using the slope pallet packed together, let the system travel and come down from the slope pallet. Then, move the system to a position in which a power outlet is provided and X-ray exposure is possible.

NOTE ***If you are not familiar with traveling of the system, let the system travel at a low speed with rigid care, then come it down from the pallet.***

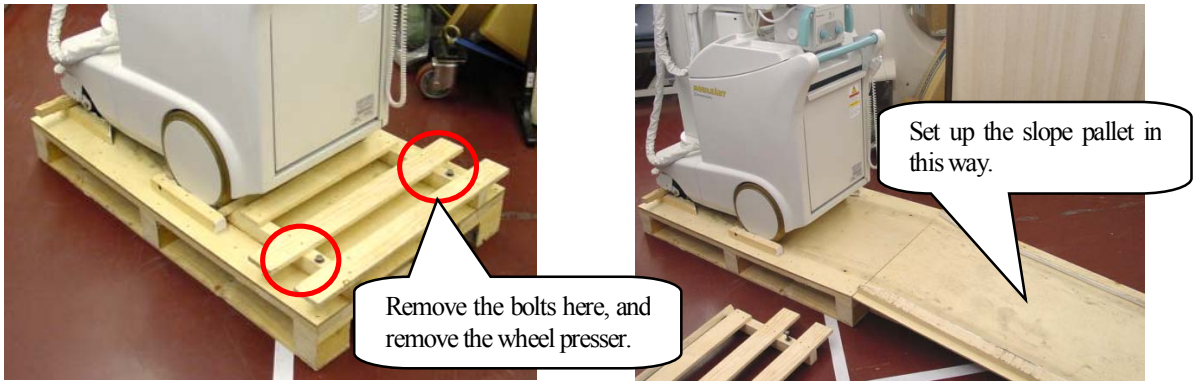


Fig. 4-2 Slope Pallet & how to use

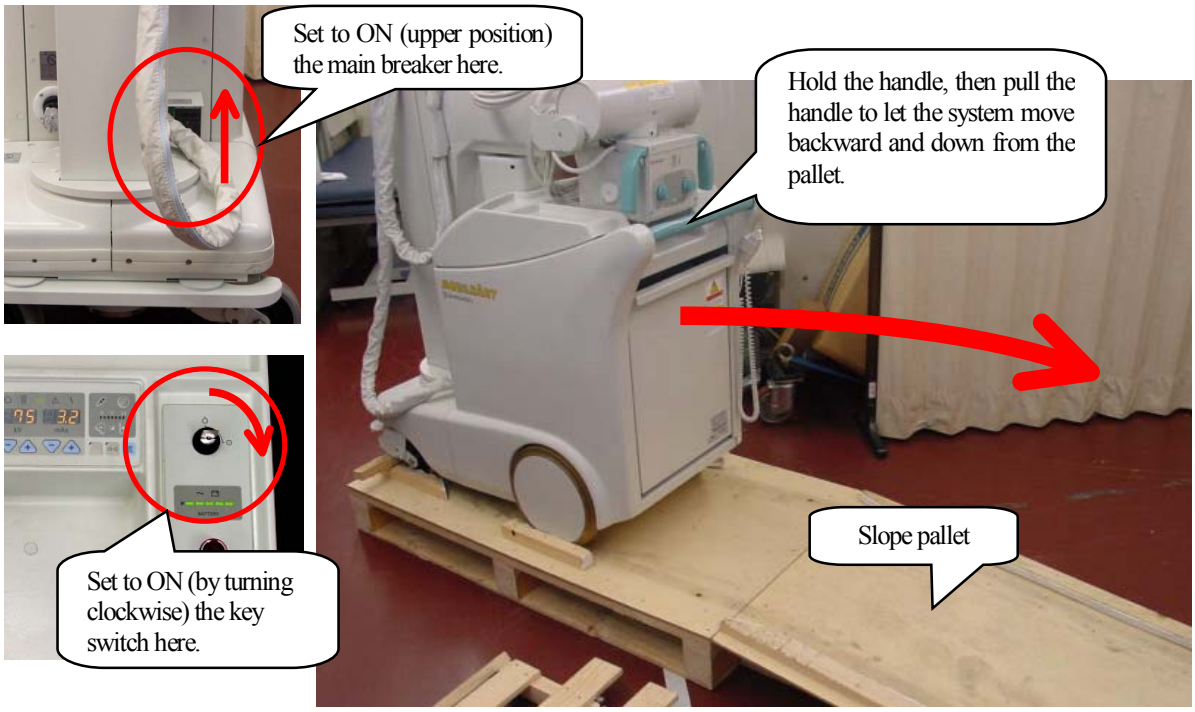


Fig. 4-3 How to Move Down the MUX

Next remove the packing wood support.
First , cut the fixing tape (between wood support and packing materials) , then remove the packing materials.
After that , remove the screws (one side 6 screws) from wood support , then remove one side of wood support.

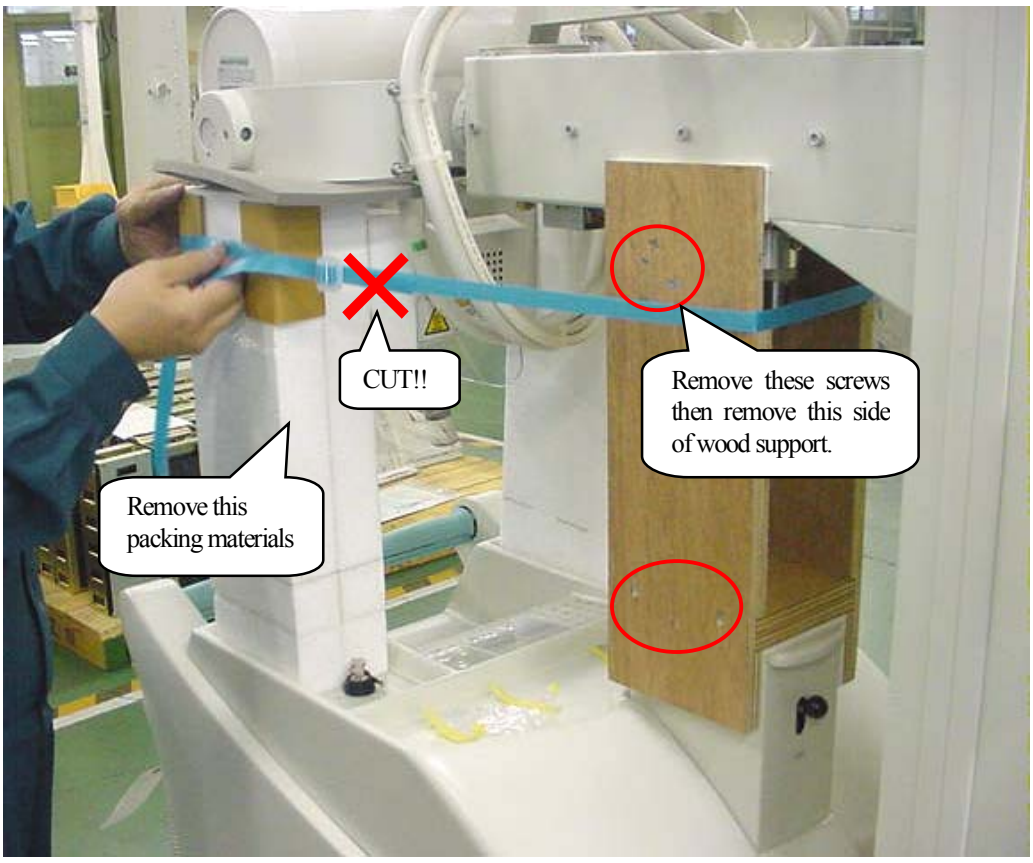


Fig. 4-4 How to Remove the packing materials

Next remove the packing wood support assembly using arm lock free switch. Then rotate the support stand .
In this time , please check the wire rope (no damaged areas , no frayed spots , element wires are not cut , the tension is equivalent between two wires) then remove the fixing bolt for weight.

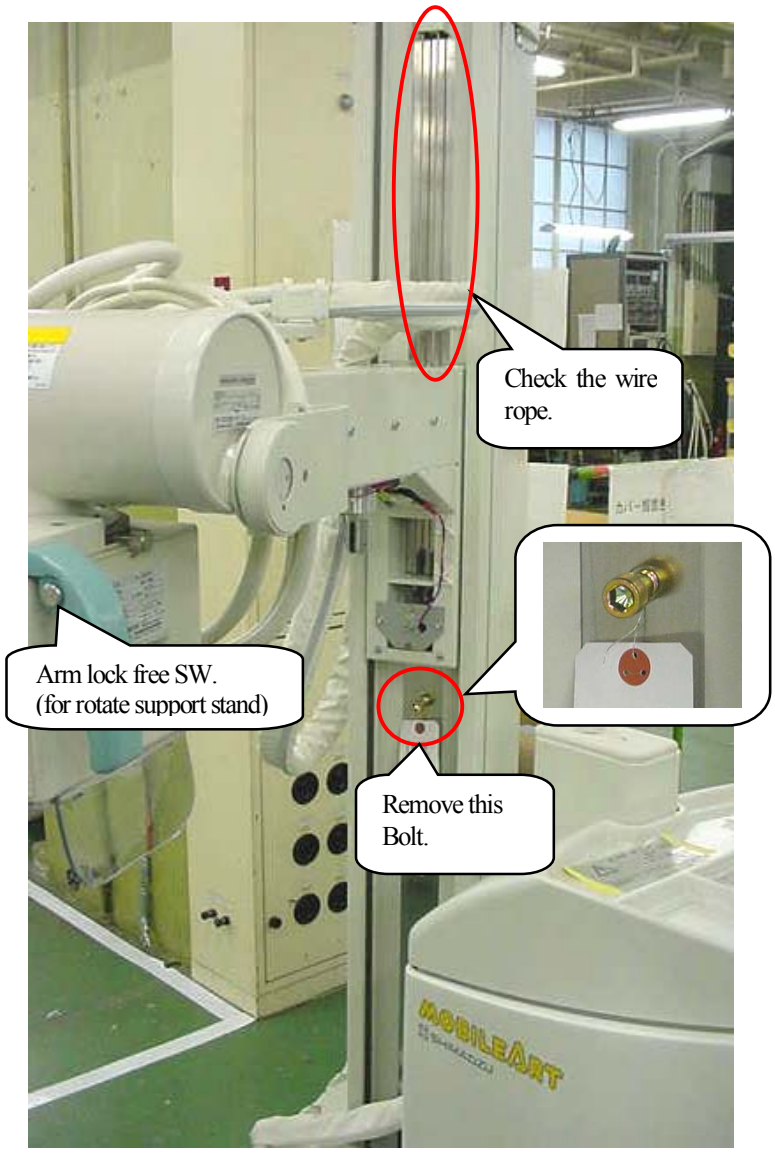


Fig. 4-5 Rotate support stand and remove fixing bolt

4-2-3 Attachment of arm cover and collimator rotation stopper

After moving down the MUX from the pallet, attach the arm cover packed inside corrugated fiberboard.
Before attaching the arm cover, set the key switch to ON and move the arm to a proper position so that the attachment work can be performed smoothly. Attach the arm cover with screws provided on the arm. After attachment, put requiring caps (for hiding screws) into a dent.
After that, attach the collimator rotation stopper knob (which is put inside a bag).

1. Lift up the arm and expand it.
2. Remove the Cable Guide from the Middle Arm. (M5 bolt, 2places. Fig.1(a))
3. Attach the Upper arm cover to the Arm. (M4 screw, 4places, Fig.1(b))
4. Attach the Lower arm cover to the Arm. (M4 screw, 6places, Fig.1(c))
5. Attach the Cable Guide to the Mddle arm. (Fig.1(d))

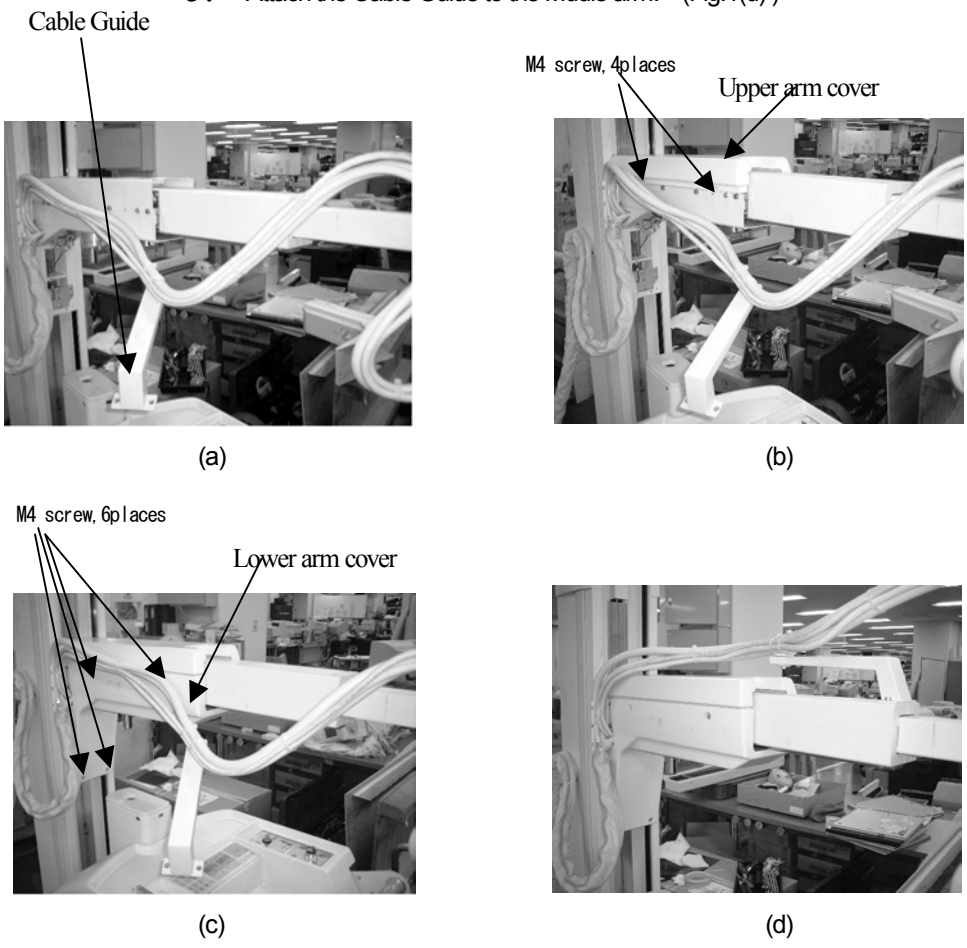


Fig. 4-6 Installation procedure of arm cover

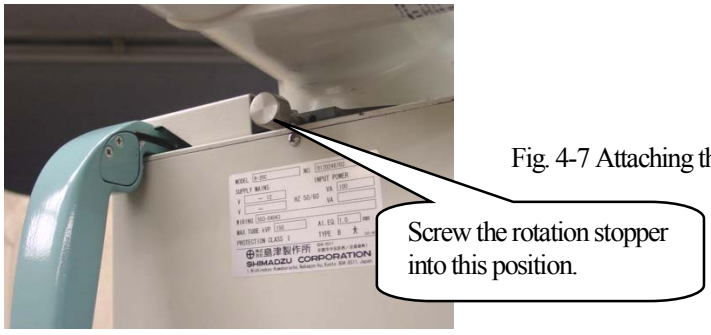


Fig. 4-7 Attaching the collimator rotation stopper knob

4-2-4 Change of connection in accordance with supply voltage

In accordance with the supply voltage adopted in the customer, change the power plug and the connections of the connector P1 and P2 in the unit according to Table. 4-1 Changing the connection according to supply voltage Fig. ***and Fig.4-8 .***

1. Turn OFF the main circuit breaker. (Refer to "1-4 Name of Each Part".)
2. Open the right side cover. (Refer to "6-1 How to Remove Covers".)
3. Change the connection of the connector P1 and P2 according to Table 4-1.
4. Stick the supply voltage indication label above the outlet of the power plug. (The label is included in the maintenance parts: P/N 502-21566.)
5. Turn ON the main circuit breaker. Also, make sure the circuit breaker NFB1 is ON (under side).

WARNING ***Make sure to change the connection in accordance with the supply voltage in the installation place. If the system is charged with wrong connection, electrical parts may be burnt and fire may occur.***
(The supply voltage is set to 100 V at shipment from the factory.)

Supply voltage	Connector P1	Connector P2
240V±10%	A0	A240
230V±10%	A+10	A220
220V±10%	A0	A220
200V±10%	A0	A200
120V±10%	A0	A120
110V±10%	A+10	A100
100V±10%	A0	A100

Table. 4-1 Changing the connection according to supply voltage

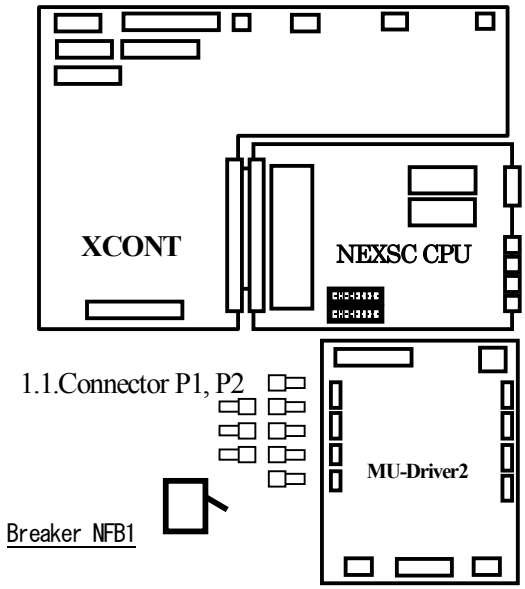


Fig. 4-8 Connector P1 and P2

4-2-5 Setting of PCBs (XCONT etc.)

Ⅰ XCONT 2002 PCB

Please set each jumpers to O side of Table. 4-2.

SW name	Silkscreen	Setup	Means
JP1	「 ON 」	○	Standard
	「 KC 」		KC signal is outputted to the terminal X2
JP2	「 C/C1 」	○	For High Voltage Trans D125PH-C/C1
	「 C2 」	×	For High Voltage Trans D125PH-C2
JP3	「 S 」	○	Master reset time Approx. 1.4 sec
	「 L 」	×	Master reset time Approx. 3.3 sec

Table. 4-2 Jumper switch setup

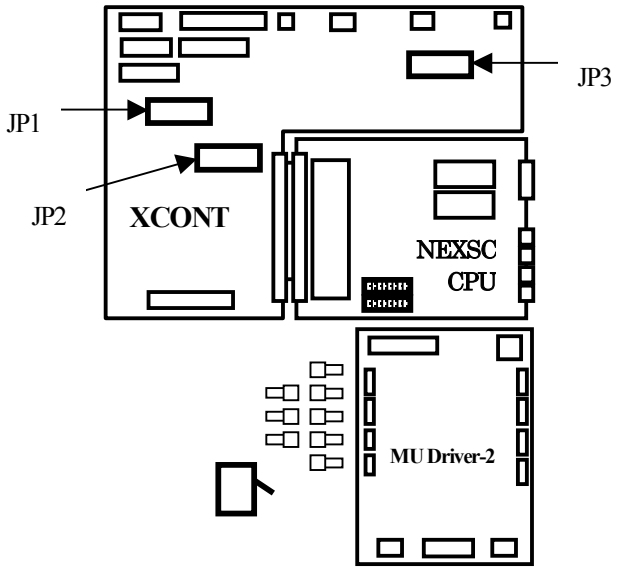
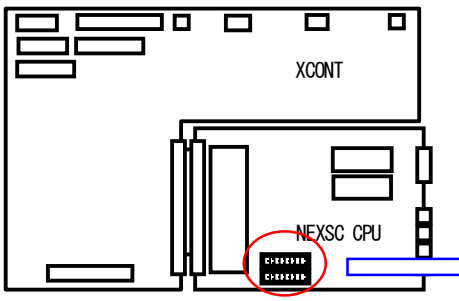


Fig. 4-9 Location of jumper switch on XCONT board

Ⅱ NEXSC PCB

Set the DIP switch SW2 and SW3 as below for normal use mode without any option.
(Set SW2-4 to ON when you attach Remote Control option.)



	1	2	3	4	5	6	7	8
SW2	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF
SW3	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF

Fig. 4-10 Setting the DIP Switch on the NEXSC PCB (for normal use mode)

Ⅲ INVERTER UNIT PCB

Set the DIP switch SW1-1 to OFF("MUX-100" side). (SW1-2 is not used.)

4-2-6 Performance Check (Confirmation of operation)

WARNING ***Change the connection in accordance with the supply voltage in the installation place first, then confirm the operation.***

I Aging

Set to ON the key switch, then perform aging as confirmation of the scan operation.
Perform scans while changing gradually the scan condition in accordance with Table 4-2 up to the step 9. If any abnormality occurs during confirmation, return to the condition former by two steps, then perform scans at each step again.
When measuring the tube voltage waveform, check the CP9 TKV (Tube voltage feedback) on the XCONT PCB using an oscilloscope.

Step	Tube voltage (kV)	Tube current time product (mAs)	Number of times	Rest time (sec)
1	60	10	2	40
2	70	10	2	40
3	80	10	2	40
4	90	10	2	40
5	100	10	2	40
6	110	10	2	40
7	115	10	2	40
8	120	10	2	40
9	125	10	2	40

Table 4-3 Aging Procedure

WARNING ***When performing aging, close the collimator completely, and take sufficient protective measures against radiation using partitions, protective apron, etc.***

II Confirmation of tube current

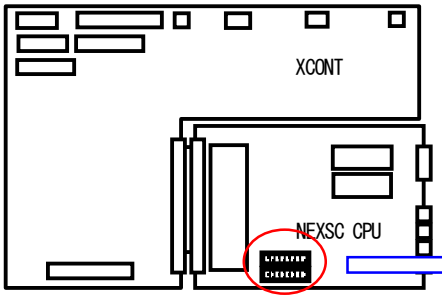
After aging, confirm the tube current using the procedure described below. Usually, only confirmation is enough, and adjustment is not required. However, if the measured values are deviated from the values shown below, adjust the tube current in accordance with "6-4 Adjustment of Tube Current".

Confirmation points
① 80 kV-50 mA point : 45 to 48mA
② 80 kV-160 mA point : 148 to 155mA

i Setting the DIP switch

In order to confirm the tube current, enter the adjustment mode. Open the right side cover of the control unit (Refer to "6-1 How to Remove Covers".), then set to ON (adjustment mode) the DIP switch SW3-8 and set to ON (measured value display mode) the DIP switch SW2-5 on the NEXSC (CPU) PCB inside the control unit.

NOTE ***When the confirmation work is finished, turn off the power and return to OFF the DIP switches.***



	1	2	3	4	5	6	7	8
SW2	-	-	-	-	ON	-	-	-
SW3	-	-	-	-	-	-	-	ON

Fig. 4-11 Setting the DIP Switches on the NEXSC PCB (for adjustment mode)

ii Selecting the tube current 2-point adjustment mode

Press the head scan key in the APR to enter the tube current 2-point adjustment mode. (The LED on the head scan key flickers.) Because the tube voltage is fixed to 80 kV, you do not have to set it. Set the tube current to two points, 50 and 160 mA, perform exposure, then make sure that the measured value is located inside the range shown at the confirmation point.

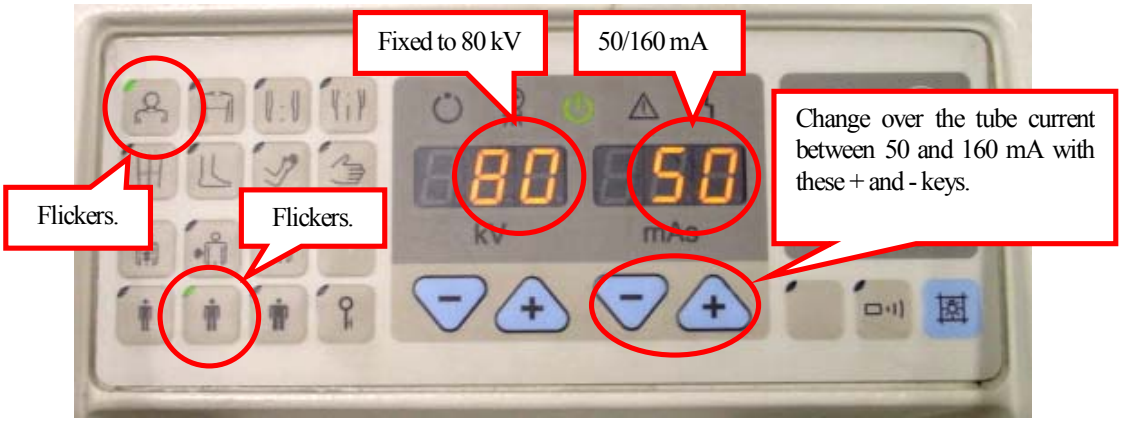


Fig. 4-12 Panel in the Tube Current 2-Point Adjustment Mode

III Confirmation of operation

i Confirming the operation of the travel handle

Set to ON the key switch to turn on the power of the system. Push the travel handle, and make sure that the system moves forward. In the same way, pull the travel handle, and make sure that the system moves backward. At this time, make sure also that the moving speed changes in accordance with the pushing/pulling force.

Next, press the arm lock release switch, and lift the tube unit. After that, manipulate the travel handle, and make sure that the system moves at slower speed compared with the status in which the tube unit is accommodated inside.

At last , make sure that the system stopped by bumper switch.

ii Confirming the operation of the fine movement switch

Press the arm lock release switch, and lift the tube unit. After that, press the fine movement switch, and make sure that the system moves in the correct direction.

Further more, make sure that the system stops when one fine movement switch is pressed while the system is moving by pressing of another fine movement switch.

At last , make sure that the system stopped by bumper switch.

NOTE ***Manipulate the fine movement switch while the arm is lifted a little from the connection area by pressing of the arm lock release switch. (While the arm is connected, the fine movement switches are disabled.)***

iii Confirming extension/shrinkage, upward/downward movement and rotation of the arm

While pressing and holding the arm lock release switch, move the arm in each of the extension, shrinkage, upward, downward and rotation directions. Check for abnormal sound and insufficient stroke. Further more, make sure that the arm lock is set when the arm lock release switch is released.

iv Conforming the operation of the collimator

At first, make sure that the collimator is mounted correctly. Loosen the collimator rotation stopper screw, rotate the collimator, and make sure that playback is not detected.

Next, confirm the light irradiation field. Turn the irradiation field adjusting knob to the completely open position, press the collimator lamp switch, and make sure that the irradiation field lamp lights. After that, turn the irradiation field adjusting knob to the completely closed position, and make sure that the light irradiation field lamp is completely extinguished.

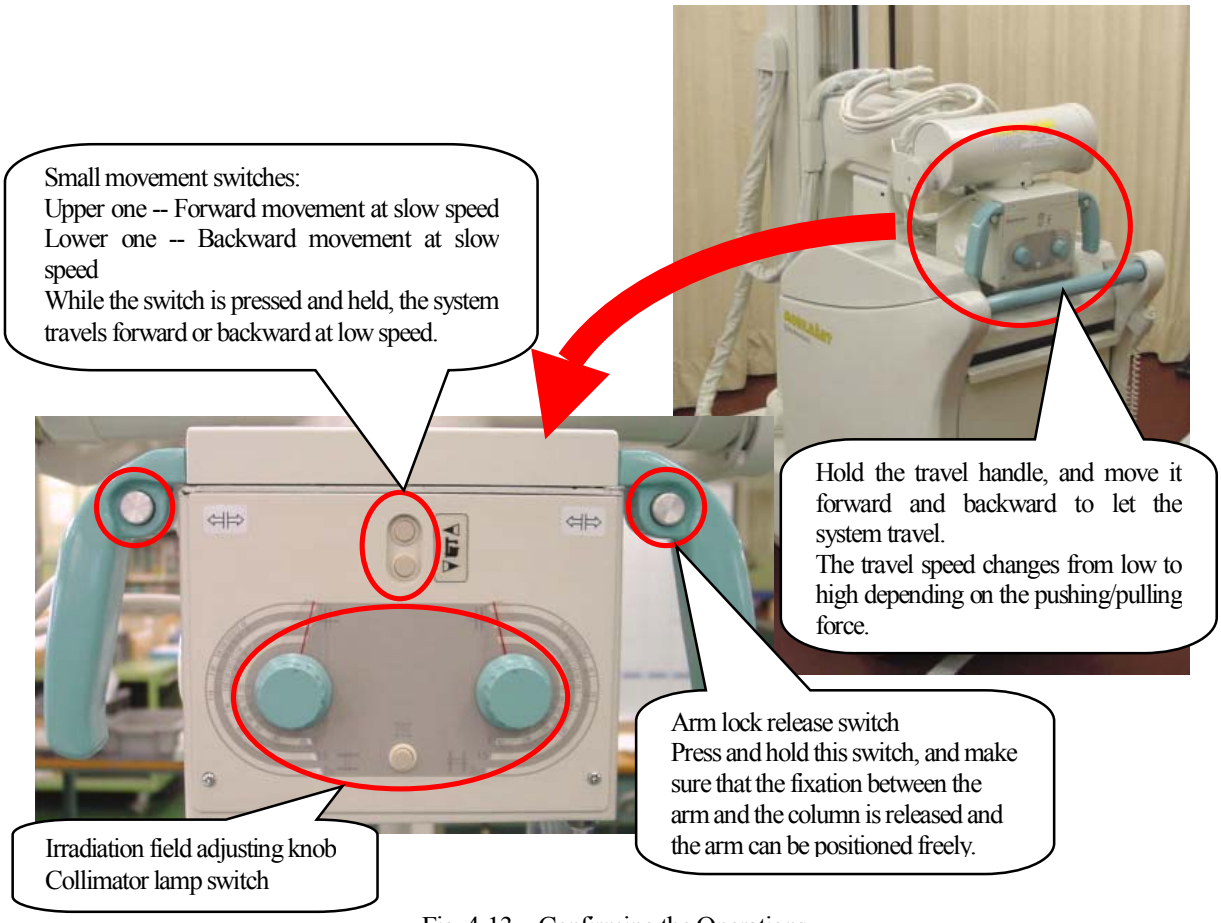


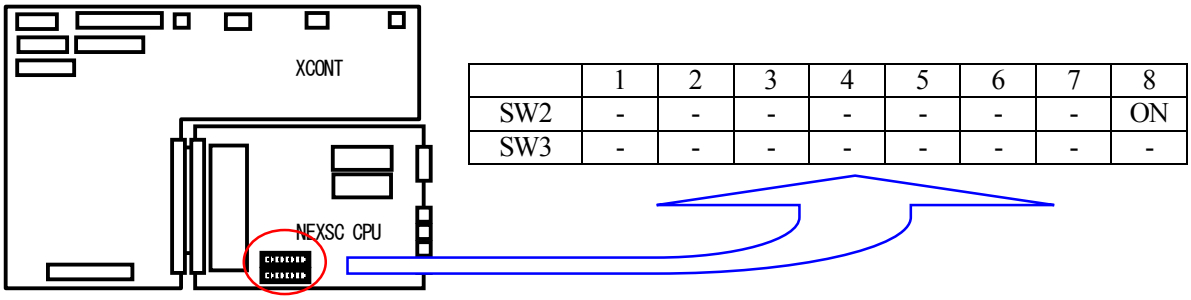
Fig. 4-13 Confirming the Operations

4-2-7 Initial setting

I Setting the DIP switch

In order to perform the initial setting, open the right side cover of the control unit (Refer to "6-1 How to Remove Covers".), set to ON the DIP switch SW2-8 on the NEXSC (CPU) PCB inside the control unit (Refer to Fig.4-14.), then turn on the power.

NOTE ***When the initial setting is finished, turn off the power and return the DIP switch to OFF. If no option will be installed, attach the right side cover.***



	1	2	3	4	5	6	7	8
SW2	-	-	-	-	-	-	-	ON
SW3	-	-	-	-	-	-	-	-

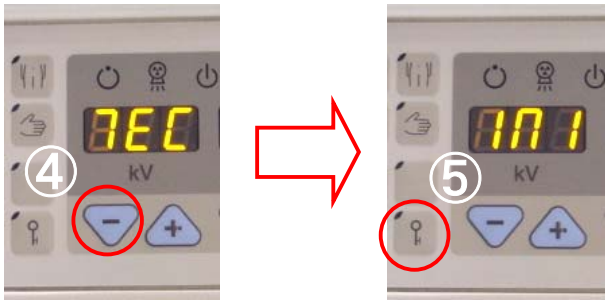
Fig. 4-14 Setting the DIP Switch on the NEXSC PCB (for Initial Setting)

Reference ***You can perform the initial setting without setting to ON the DIP switch on the NEXSC PCB.***

At first, press and hold the user setting switch for 3 seconds to change into user setting mode. When "PAS" is displayed, press the head scan key and the collimator lamp key consecutively in this order within 3 seconds (Do not confuse the keys.). When "TEC" (indicating the adjustment mode) is displayed in the tube voltage display unit, change the display to "INI" (indicating the initial setting mode) using the tube voltage setting keys. At the end, press the registration key. Then, the system is set to the initial setting mode without setting to ON the DIP switch.

At first, press and hold the user setting switch for 3 seconds to change into user setting mode.

When "PAS" is displayed, press the head scan key and the collimator lamp key consecutively in this order within 3 seconds.



When "TEC" is displayed, change the display to "INI" (indicating the initial setting mode) using the tube voltage setting keys. Then, press the registration key.

Fig. 4-15
Panel Display in the Initial Setting Mode

II Selection of battery type

Set the type of batteries mounted in the system.
Set the battery code displayed in the tube current time product display unit (mAs) on the operation panel using the tube current time product setting key (△). (For the contents of setting, refer to Table 4-5.) When the setting is completed, press and hold the registration key until "CALend" is displayed.

NOTE ***At the time of shipment from the factory, the battery code is set to "4". The setting does not have to be changed in the installation work.***

NOTE ***Compared with the standard battery, the number of available scans, the travel distance, etc. offered by the LC-P127R2 manufactured by Matsushita Battery Industrial by one-time charging are considerably worse. It is recommended to use the standard battery so that the system can offer its full performance.***

CAUTION ***The characteristics vary depending on the battery type. If a wrong code is set, scans, traveling and charging may not be performed correctly. In the worst case, electrical parts may be burnt or fire may occur.***

Set code	Type of Battery (Manufacturer)
0	OLD PXL12072 (Japan Storage Battery) Manufacture date No.-000703
1	LC-P127R2 (Matsushita Battery Industry Co. Ltd.)
2	Not used
3	NEW PXL12072 (Japan Storage Battery) Manufacture date No.-000712
4	PX12090 (Japan Storage Battery)

Table 4-5 Contents of Setting of Battery Type

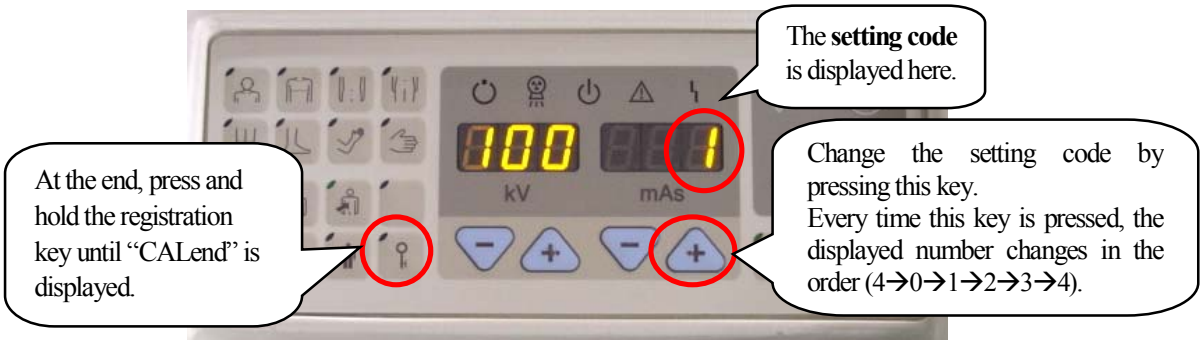


Fig. 4-17 How to Set the Battery Type

4-2-8 User Setting

According to the request from the customer, change each user setting.

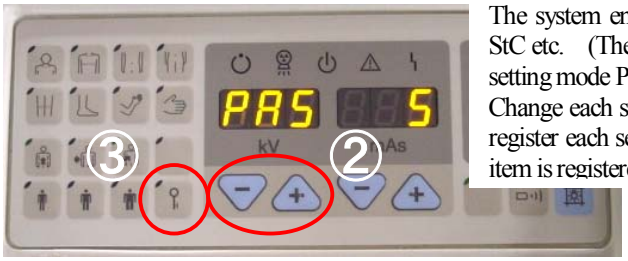
I How to enter user setting mode

Press and hold the user setting switch for 3 seconds to change into user setting mode. .
"usroPe" is displayed (for approximately 1 second), then the contents of user setting are displayed in the tube voltage display unit. The contents of user setting can be changed by using the tube voltage setting keys "△" and "▽".

kV display	Item
PAS	Power-assist setting
Acc	Acceleration setting
StC	Steer control setting
bAC	Backward power-assist setting
APO	Auto-power-off time setting
bON	Buzzer control setting
LAP	Collimator lamp control setting
aPr	APR setting at the time of starting the apparatus
id	Apparatus ID setting

Table 4-6 Contents of User Setting

Press and hold the user setting switch for 3 seconds.



The system enters the user setting mode such as PAS, Acc, StC etc. (The photograph on the left shows the power assist setting mode PAS.)
Change each set item using the tube voltage setting keys, and register each set item using the registration key. When a set item is registered, the system returns to the normal use status.

II How to return to normal use status

Press the user setting switch in user setting mode.
At this time, if the contents of user setting are not registered by the registration key, the changing of contents are canceled.

Press the user setting switch to return to the normal use status.

In this Service manual, "PAS" and "APO" only are explained below.
Refer to "4.8 User Setting" of Operation Manual regarding other items of user setting.

Ⅲ *Setting of power assist*

At first, select the power assist setting in user setting mode.
At this time, "PAS" (power assist setting) is displayed in the tube voltage display unit, and the current preset value is displayed in the tube current time product display unit.

NOTE ***At the time of shipment from the factory, this item is set to "70" (standard).***
In case that you change it to higher value, for example to "100", the noise from DC Motors may become bigger.

Change the preset value using the tube current time product setting keys, then press the registration key to register the contents of setting. Then, "reCord" is displayed in the display unit, the contents of setting are registered, and the system returns to the normal use status.

mAs display	Content of power assist setting
100	Light
95	↑
:	↑
75	↑
70	Normal
65	↓
:	↓
35	↓
30	Heavy

Table 4-7 Contents of Setting of Power Assist

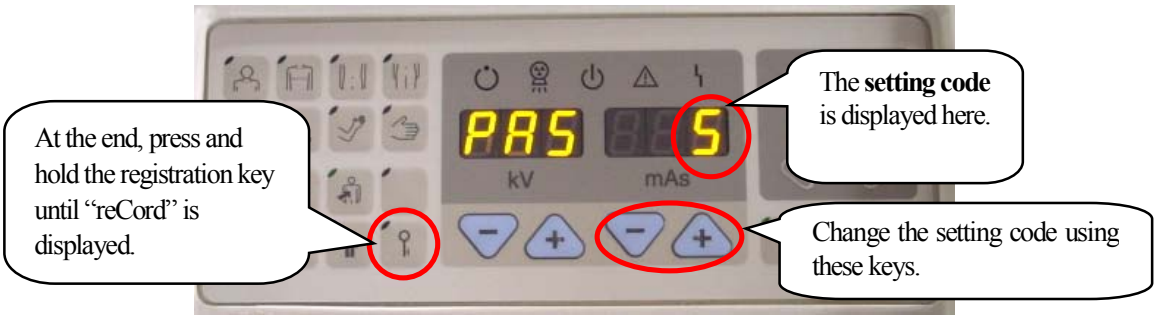


Fig. 4-18 How to Set the Power Assist

IV Setting of auto power OFF

At first, select the auto power OFF setting in user setting mode.
At this time, "APO" (auto power OFF setting) is displayed in the tube voltage display unit, and the current preset value is displayed in the tube current time product display unit.

NOTE ***At the time of shipment from the factory, this item is set to "15" (The power automatically turns OFF 15 minutes later.).***

Change the preset value using the tube current time product setting keys, then press the registration key to register the contents of setting. Then, "reCord" is displayed in the display unit, the contents of setting are registered, and the system returns to the normal use status.

Tube current time product display (setting code)	Contents
--	The auto power OFF function is not valid.
05	The power automatically turns OFF 5 minutes later.
10	The power automatically turns OFF 10 minutes later.
15	The power automatically turns OFF 15 minutes later.
20	The power automatically turns OFF 20 minutes later.
30	The power automatically turns OFF 30 minutes later.

Table 4-8 Contents of Setting of Auto Power OFF

Fig. 4-19 How to Set the Auto Power OFF

4-2-9 Installing CXDI-50G

1. Turn off the main circuit breaker.
2. Open the right side cover, top cover, cable cover and FPD box.
3. Wiring of the CXDI-50G

- Fix the sensor cable so that the length between the cover and the FPD is 4.5m or less. (Refer to Fig.4-20 (a).)
- Perform internal cable wiring referring to Fig.4-20 (b),(c). (Arm Joint Section and Link Assy are should be removed once to fix the sensor cable under the Arm Joint Section.)

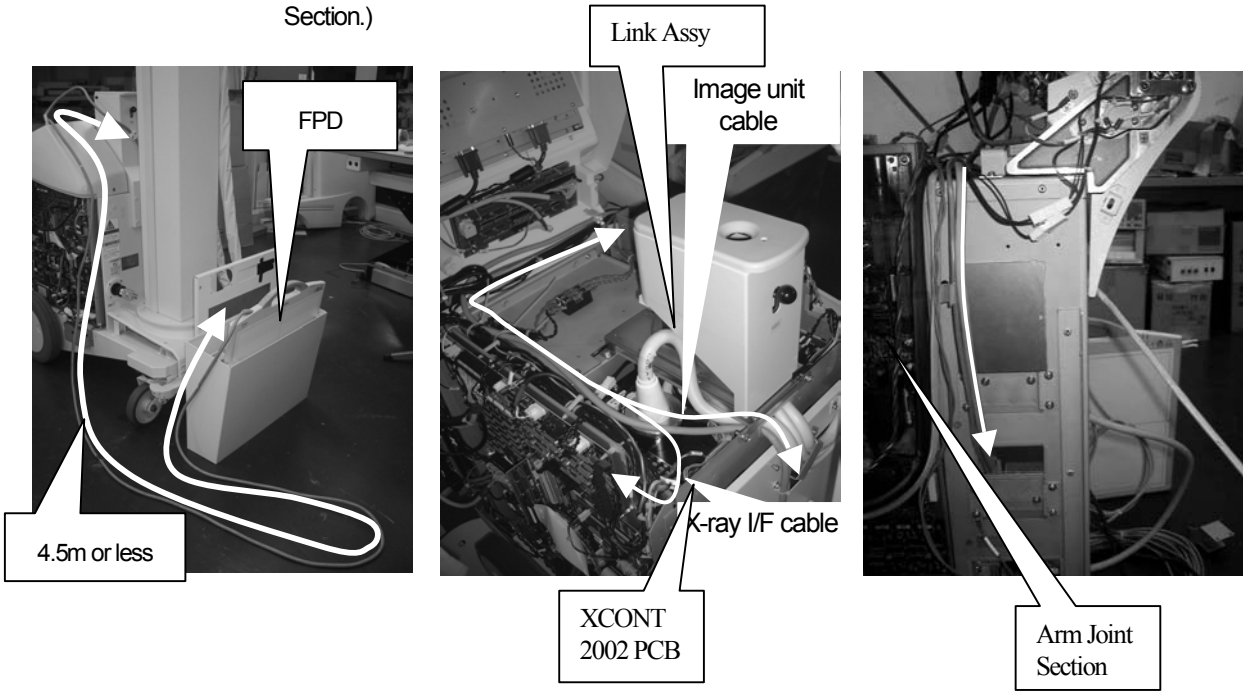


Fig.4-20 Wiring of CXDI-50G

- Open the cover of Power Box of CXDI-50G, then connect the sensor cable from FPD according to "CXDI-50G Service Manual".

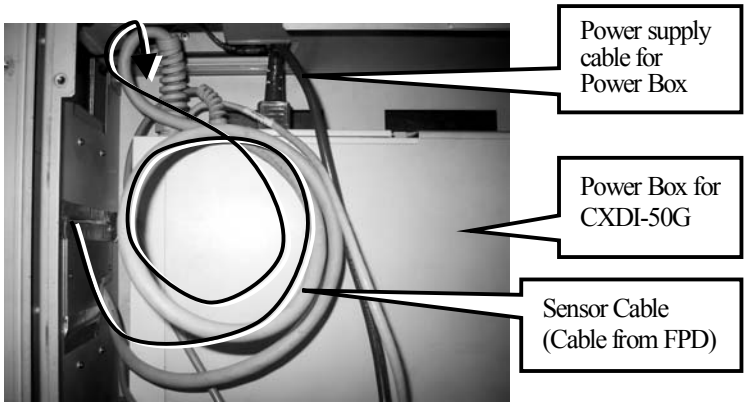


Fig.4-21 Wiring of Power Box

4. Connect X-ray I/F cable which is included in CXDI-50G between Power Box and XCONT 2002 PCB. (Refer to Fig.4-22 and "CXDI-50G Service Manual".)

Wire Marking	Terminal on XCONTPCB
A1	1B2
A2	1B22
B1	1B1
B2	1B11

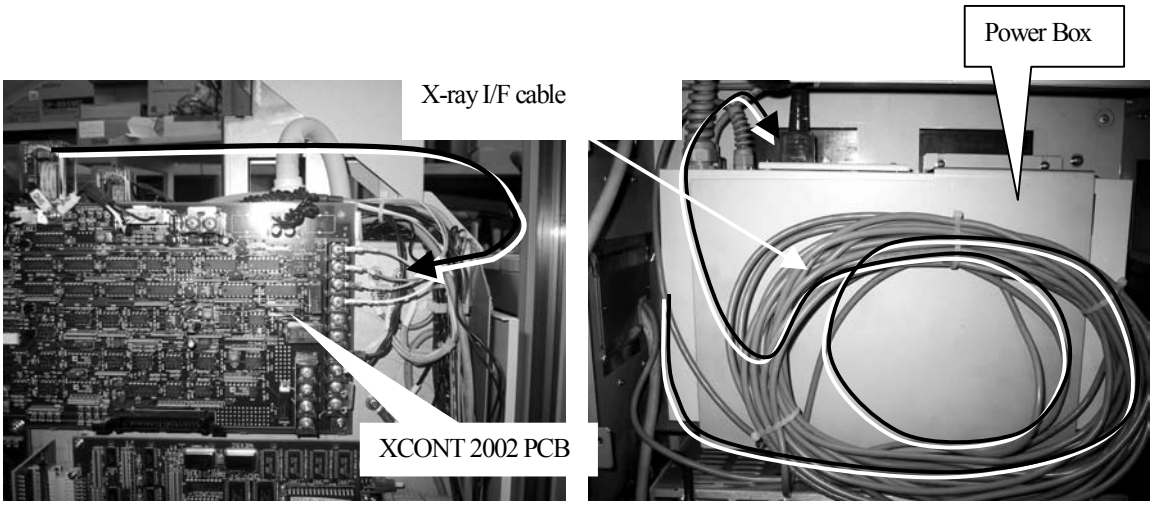


Fig.4-22 Wiring of X-ray I/F cable

- Attach the cover of Power Box.

5. Connect the power supply cable which is included in CXDI-50G between Power Box and DC/AC converter. (Refer to Fig. 4-23.)

6. Connect the LAN cable between Power Box and the PC.

7. Fix the Power Box on the Mount Plate, then fix it with the fixing plate. (Remove the four rubber spacer which are attached on the bottom of Power Box , and turn on the Line ON switch of Power Box before fixing it to the main frame of MUX-100D.)

8. Fix the cables to Power Box with the Cord Bracket. (Refer to Fig. 4-24.)

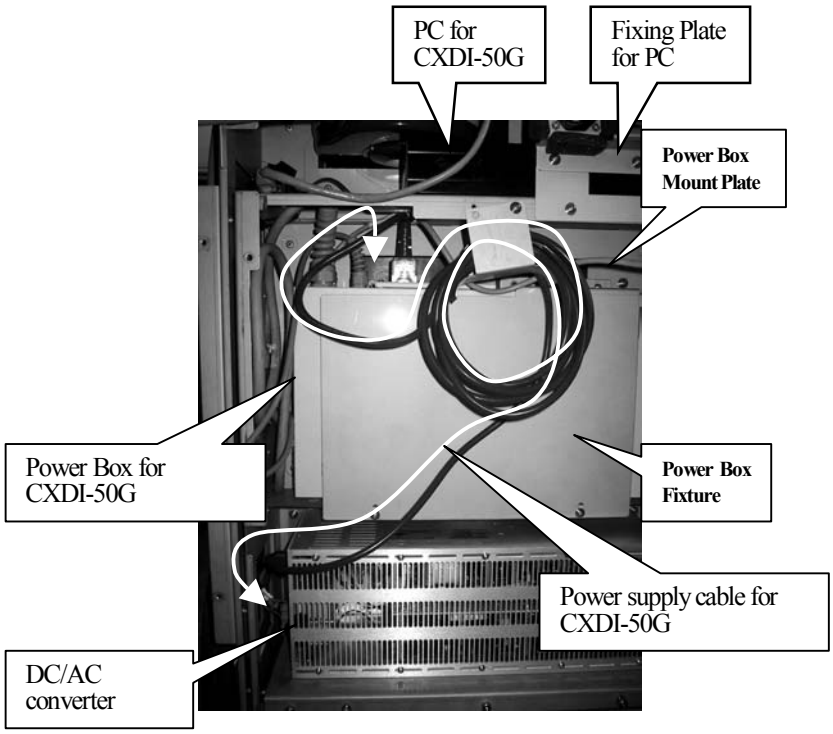


Fig.4-23 Fixing and Wiring of Power Box

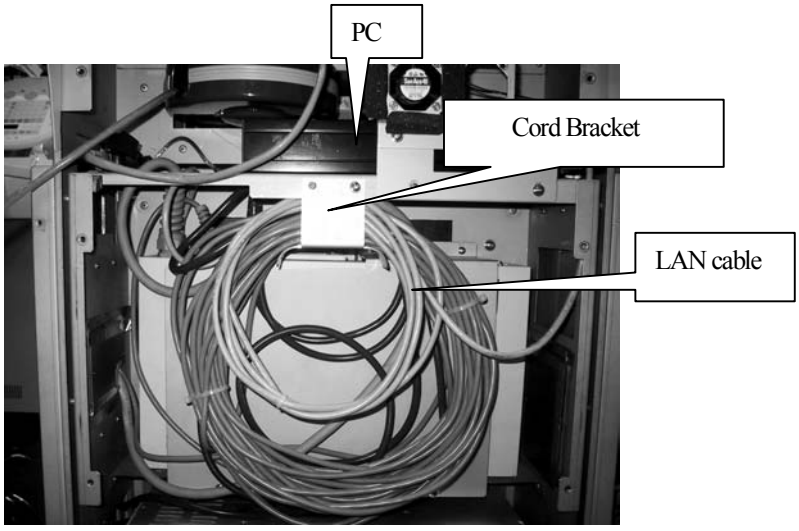


Fig.4-24 Fixing the cables of Power Box

9. Remote Switch which is included in CXDI-50G is not used.

10. Turn on the main circuit breaker.

11. Set CXDI-50G referring to “CXDI-50G Service Manual”.

(1)Network Settings
(2)Linearity check of Transfer Image Density.
(3)Operation Unit Gamma correction.
(4)FD Backup of data that sets backup when it is set.
(5)Calibration

- The exposure condition of the calibration is aprox. 60kV, and 2mAs at the exposure distance (SID) 1m.

- The calibration error might occur because of differences the exposure distance (SID) and the X-ray back scatter etc. When the calibration error occurs, the error screen is displayed in the touch panel monitor. Check the content of the error, and change the calibration condition (exposure conditions of MUX). % is displayed to the average of dose product. Lower the calibration condition when the displayed value is large. Raise the calibration condition when the displayed value is small.

- Set to the exposure condition used for the calibration from the touch panel monitor to CXDI-50G when the calibration ends. (In a self-diagnosis and the next calibration, the set exposure condition is displayed in the touch panel monitor as a reference exposure condition.)

(6)Self Test

- Self-test condition is the same as calibration condition.

12. Attach the cover.

4-2-10 Charging

In order to stabilize the battery performance, use the system after installation until the red LED of battery charging indicator lights on, then charge the batteries.

<After Installation>

Explain to the user to perform above charging-discharging cycle several times in the first use of the system after installation. (Refer to "4.7 Charging the Battery" in Operation Manual of MUX-100D.)

In other words, explain to the user to use the system until the batteries are almost completely discharged.

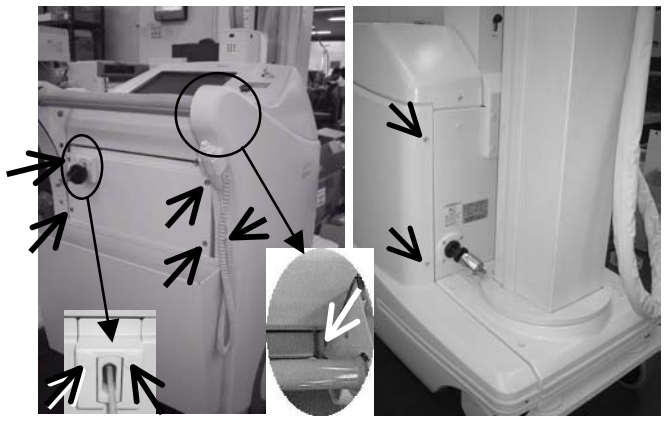
After the first use of the system, it is recommended to recharge the battery after two or more green LEDs of the battery indicator light off for a long life and good performance of the battery. Too frequent charging may lower the performance and reduce the battery life.

<Difference from MUX-100/100H>

Function of battery charging is different from MUX-100/100H series. (Refer to "3-2-4 Charging circuit".)
If the key switch is set to OFF and DR system is turned OFF , battery charging will start when the power plug is connected, regardless of the current battery charged voltage.
(In case of MUX-100/100H, the battery charging does not start if the current battery voltage is high.)
Because the battery also should supply the power for DR system in case of MUX-100D.
So, MUX-100D has new function for controlling battery charging current more accurately to avoid over-charged condition of the battery. But, anyway, the above caution for battery charging procedure is recommended to follow as same as MUX-100/100H series for a long life and good performance of the battery.

4-2-11 Attachment of screw caps

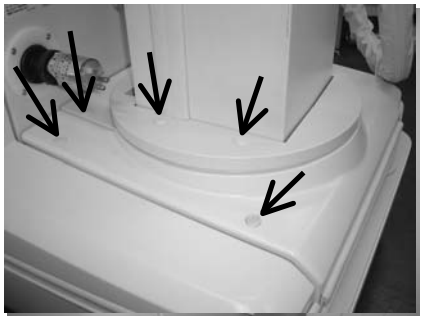
At last , attaching the screw caps in the screw holes of each covers.



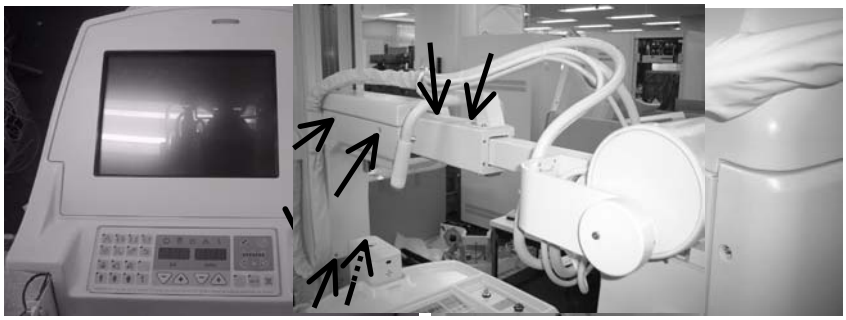
Side Cover: 4pieces on each sides

FPD BOX : 6 pieces

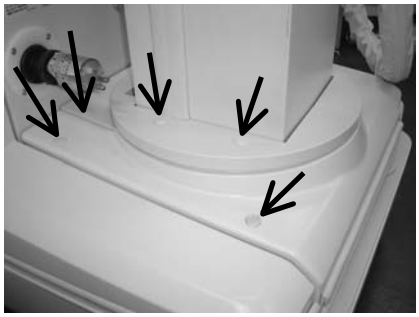
Collimator: 2pieces



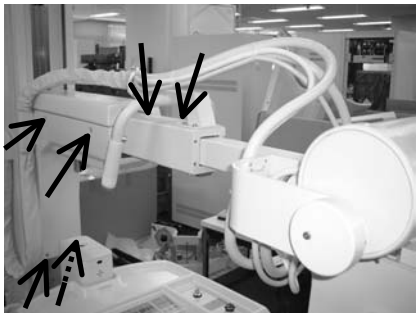
Top Cover: 3pieces



Cable Cover: 4pieces



Front Cover 4pieces, Front Rear Cover2pieces,
Column Cover 4pieces Total:10 pieces



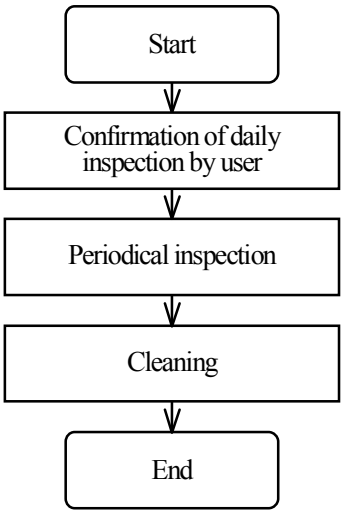
Arm Cover 6pieces
Middle Arm 2pieces

Fig. 4-25 Attaching the requiring caps

4-3 Maintenance/inspection Procedure

4-3-1 Flow chart in maintenance/inspection procedure

When perform maintenance/inspection of the MUX-100D series , follow the flow chart below.



Perform confirmation while referring to 4-3-2.

Perform periodical inspection while referring to 4-3-3.

Perform cleaning while referring to 4-3-4.

Fig. 4-26 Flow Chart in Maintenance/Inspection Procedure

4-3-2 Confirmation of daily inspection by user

Table 4-9 shows the daily inspection items requested to the user in the instruction manual. Ask the user whether the user is performing daily inspection. Check the daily inspection items upon necessity.

Item	Check point	Remark
Appearance	Any damage (physical damage) to the cover?	
Wheels and their surroundings	Any abnormal vibrations or sounds occurring while driving the unit. Any physical damage to the front wheels?	
Driving handle	Any unusual looseness?	
X-ray Tube Support stand	Any abnormal sound occurring during rotation or signs of physical misalignment or damage?	
Tube arm	Any scratches or abnormal sounds occurring during up/down movement and expansion/ contraction? Can the tube arm couple to the locking section without undue stress?	
Catch Section	Is the top plate loose? Does it rattle or make noise?	
Arm catch	Any unusual looseness?	
X-ray Tube holder	Any loose parts?	
Collimator and its attachments	Are the collimator and handle bars fixed correctly?	
X-ray control panel	Any flicker or abnormal display?	
HT Cables and other cables	Any twisting or physical damage of the outer insulation?	
Counterbalance Wire	1) Any strand of the rope frayed or damaged?	Refer to "Periodical

	2) Any corrosion?*	inspection" on the next page.
Bumper Bumper switch	Do you operate normally? Any loose parts? Is the cover correctly attached? Does the bumper switch operate normally?	
Catcher part	Any unusual looseness to the top plate?	
Earth belt	1) Does it appear (look) normal? 2) Is any debris attached to the belt?	Remove dust, when dust has adhered to the belt.
Power plug	Is there any gap between the plug and the stopper? Are any of the plug's prongs bent or deformed?	
Cord reel	Is anything caught in it and making noise? Is the cable cover cut or frayed?	
FPD box fan vent holes	Is dust collected on the vents? Is air being exhausted normally from the vents?	
Others	Any presence of unusual smells or abnormal sounds when the power is turned on or while the battery is being charged? Any abnormal sound or vibration coming from the X-ray tube assembly?	

Table 4-9 Daily check items

Please refer to Chapter 6.1 "Inspection" in Operation Manual of MUX-100D about the detail of daily inspection of each parts. Regarding inspection for CANON FPD, please refer to Operation Manual of CXDI-50G.

4-3-3 Periodical inspection

CAUTION ***The special serviceman who received education surely needs to carry out a scheduled inspection.***

When performing the periodical inspection upon request from the customer, follow the items shown in Table 4-10. For inspection, covers should be removed. Remove them while referring to 6-1.

Periodical inspection

Even if any anomalies are not found during the daily inspections, your nearest authorized Shimadzu service center should check the following items. It is recommended to carry out the periodic check every 6 months.

Item	Check point	Remark
Support stand (Column)	Check all fixing bolts and screws	Remove the covers from the root of the column and the arm.
Battery	1) Appearance? 2) Correct voltage? The batteries are recommended to be replaced every 2 years. Contact your nearest authorized Shimadzu service center for the necessary replacement. Replace batteries when a fully charged set of batteries have a reduced operational life. Shimadzu part number 074-71031-02 20 pieces	Remove the side cover.
Power supply	Output voltage normal?	Remove the side cover.
X-ray output	Check X-ray tube voltage and mAs.	Remove the side cover.
Wire rope	1) Any frayed or broken strands? 2) Is the fixing point normal? 3) Is the rope lubricated? 3) Any deformation or corrosion?* The wire rope must be replaced at least every 10 years from the date of original equipment delivery. Contact your nearest authorized Shimadzu service center for the necessary replacement. Shimadzu part number (2 pieces for 1 unit) 503-46520 for MUX-100D 503-46520-03 for MUX-100DJ	Remove the covers from the column and the arm.
X-ray tube rotation	Is the rotation lubricated?	
Arm catch	Check storage. 1) Are you fixed? 2) Any unusual looseness? 3) Confirmation of storage signal	

Tube arm	Any scratches or abnormal sound occurring during up/down movement?	
Bumper	Do you operate normally? Any loose parts?	
Earth belt	Does the belt touch the floor? The belt is not short or cut? (Copper wire in the lower portion of the main unit)	Remove dust, when dust has adhered to the belt.
DC motor	The key on the motor shaft is not loose? The wheel doesn't shake?	
Brake for DC motor	The bar of a travel brake operate certainly?	
Casters	The fixing of each casters are not loose? (4 mounting screws provided in the lower portion of the main unit)	
FPD Bin	Are support cushions obstructed?	
Grid holder	Is not the part where the grid case is installed transformed?	
Cable	Any twisting or damage to the cable?	
Internal inspection	Confirm the connectors.	Remove the side covers Arm covers Top cover
Power plug	Is there any gap between the plug and the stopper? Are any of the plug's prongs bent or deformed?	
Cord reel	Is the cable cover cut or frayed? Is anything caught in it and making noise?	

Table 4-10 Periodical check items

4-3-4 Cleaning

When the inspection is finished, wipe dirt off the surface of the system with cloth soaked in neutral detergent for home use, etc. carefully so that the surface is not damaged.

CAUTION	*This system is not protected against invasion of liquid. During cleaning, pay rigid attention so that any liquid does not enter from openings in the system.*
NOTE	*Never use organic solvent such as thinner. However, alcohol for disinfection is allowed. If the film developing liquid is adhered on the operation panel, the panel may be discolored. Wipe it off promptly.*

4-4 Consumable Parts List

Table 4-11 shows the consumable parts used in the system.
When replacing a consumable part, use a specified genuine part.

Part No.	Part name	Recommended replacement cycle
074-71014-01	Battery (20 batteries/system should be replaced at the same time.)	2 years
501-78646	CPU backup battery	1 year
065-80874-56	Relay, G7J4A-T-KM DC24V (K14,K16 for DC motor)	2 years
064-90066-01	SW, selector HW1K-2B40 (Key switch)	5 years
064-60785-97	SW, AVLW32211D-R (STOP switch)	
503-49045	Cord reel (Power plug)	Judge the replacement timing by periodical inspection.
511-70147	Cord reel (LAN)	
503-46520-01 503-46520-03	Wire rope (for MUX-100D) Wire rope (for MUX-100DJ)	
036-11143-21	O-ring, 4D SS-060 (For collimator leaf : 8 pieces/system)	
Refer to the list below.	Fuse	2 years
503-34889-02	GND Wire (Earth belt)	
532-23029	Silicon packing (standard plug at the H.T. tank side)	1 year (Refer to "Appendix F Operation of High Voltage cable" of Installation Manual.)
511-15061-11	Contact pin for replacement (standard plug at the H.T. tank side)	
511-15061-13	Mini plug maintenance kit (mini plug at the X-ray tube side)	
062-65003-02	Halogen lamp (For collimator)	1 year
511-37058	Wheel, ZP-W1 (2 pieces/system)	5 years
503-60496	Wheel cover (2 pieces/system)	
541-53637	Cap, reworks (For wheel cover : 6 pieces/system	
511-37075	Wheel, 439S-150 (For casters : 2 pieces/system)	
511-18026-01	Cable cover (between X-ray tube and the arm)	
511-18026-02	Cable cover (between the arm and the main body)	

Table 4-11 Consumable Parts List

P/N	Rating	Fuse name and location
072-06033-08	100A 600V (Rapid)	F1 (On INVERTER UNIT-C1 board)
072-01664-34	6.3A 250V (Slow blow)	F13 (On CONTROL UNIT MUX chassis)
072-01664-15	0.5A 250V (Slow blow)	F11,F12,F23 (On CONTROL UNIT MUX chassis) F1 (On MUX CHARGE-04A board) F6 (On MUX POWER-99 board)
072-01664-26	2A 250V (Slow blow)	F21,F22 (On CONTROL UNIT MUX chassis) F1,F2 (On MUX POWER-99 board)
072-01664-33	5A 250V (Slow blow)	F11,F12,F23 (On CONTROL UNIT MUX chassis) F3,F7,F8 (On MUX POWER-99 board)
072-01659-83	10A 250V (Slow blow)	F4,F5 (On MUX POWER-99 board)
072-01665-34	10A 250V (Slow blow)	F9 (On MUX POWER-99 board)
072-01005	2A 250V (Slow blow)	F21,F22 (On Link Assy)

Table 4-12 Used Fuse List

5-1 NEXSC PCB

Function

This is the CPU PCB which controls MUX-100D using the software. Different from the NEXSC PCB used in other generators and fluoroscopy units, this NEXSC PCB is not equipped with an optical cable connector. (The NEXSC PCB equipped with an optical cable connector can be used in the MUX-100D.)
The following data is stored in this PCB. It is recommended to back up the following data in preparation for PCB replacement.

Initial setting data
FVR value
Phototimer tube voltage correction value
APR
Number of times of exposure

During PCB replacement

When replacing the PCB, set the DIP switches first, then initialize the PCB. After that, perform the initial setting, adjust the FVR and register the APR.

Lithium battery replacement

When the life of the lithium battery is expired, the information (contents displayed just before the power was turned off last time, the error log and the time setting) stored in the SRAM will be erased. When the message requesting battery replacement is displayed, replace the battery using the following procedure.
① Turn on the power. ON → ② Replace the existing lithium battery with a new one. → ③ Confirm the operation.

LED list

LED No.	Description
LD1	Indicate the status in the 7-segment display area as shown below.
LD2	
LD3～6	Flickers while the X-ray tube is released.

Meaning of indication by the LD1 and the LD2 in the 7-segment display area

SS: An input is given from a sheet key.
On: Exposure is being performed.
OF: Exposure is finished.

Check pin list

CP No.	CP Name	Description
CP1	System clock	CLK6M
CP2	System clock	CLK12M
CP3	Vbatt	Lithium battery voltage
CP4	+5V	+5V
CP5	DGND	GND

DIP switch list

SW No.	Status	
2-1	Always ON	
2-2	Always ON	
2-3	Always OFF	
2-4	Always OFF	
2-5	ON: Measured value display mode	OFF: Normal mode
2-6	Always OFF	
2-7	Always OFF	
2-8	ON: Initial setting mode	OFF: Normal mode
3-1	ON: EEPROM initialization mode.	OFF: Normal mode
3-2	Always OFF	
3-3	Always ON	
3-4	ON: Remote control option is provided.	OFF: Not provided.
3-5	Always OFF	
3-6	Always OFF	
3-7	Always OFF	
3-8	ON: Adjustment mode	OFF: Normal mode

5-2 X CONT-2002 PCB

Function

This PCB equipped with the following circuits performs general control.

1. I/O circuit, A/D circuit and D/A circuit to transfer data to NEXSC PCB
2. Circuits to detect and feed back TKV and TMA
3. TKV OVER detection circuit (X-ray tube discharge detection circuit)
4. System timer circuit (X-ray cutoff signal)
5. IGBT drive control circuit
6. Filament heating FET drive control circuit
7. Dynamic display control circuit, sheet key input circuit and sheet key search circuit
8. -15V detection circuit
9. Power ON reset circuit (master reset signal)
10. Charging control
11. Interface circuit with each PCBs

During PCB replacement

The VR1 (mAs), the VR2 (VFADJ) and the VR3 (PULSEADJ) should be adjusted.
Refer to "Appendix C.3 X CONT-2002 Adjustment Method" in Installation Manual.
As well, confirm the detected battery charged voltage referring to "6-2-3 Confirmation of battery voltage detection".

LED list

LED No.	Signal Name	Description
LD1	KEY IN	Lights when an input is given from the panel.
LD2	AR	Lights when the READY switch or the first step of the hand switch is pressed.
LD3	HX	Lights when the X-RAY switch or the second step of the hand switch is pressed.
LD4	CHON-O	Lights during charging.

VR list

VR No.	VR Name	Description
VR1	mAs	Adjusts the mAs clock.
VR2	VFADJ	Adjusts the inverter working frequency.
VR3	PULSE ADJ	Adjusts the IGBT gate pulse.

Check pin list

CP No.	CP Name	Description
CP1	+5V	+5V
CP2	GND	GND
CP3	CHECK1	To be short-circuited during adjustment. Short-circuit them first, then turn on the power. Short-circuiting them in the power ON status is invalid. Refer to Appendix C in the Installation Manual.
CP4	CHECK2	
CP5	VSIN	15V input during adjustment. Refer to Appendix C in the Installation Manual.
CP6	IFST	Filament heating voltage signal (after correction)
CP7	IFV	Measured filament current (1V/1A)

CP8	VS	Inverter working frequency voltage until the tube voltage reaches the preset value
CP9	TKV	Measured tube voltage (1V/20 kV)
CP10	VN	Reference inverter working frequency voltage after the tube voltage reaches the preset value
CP11	TMA	Measured tube current (1V/50 mA)
CP12	PKV	Preset tube voltage (1V/20 kV)
CP13	RMA	Preset tube current (1V/50 mA)
CP14	FVR	Preset filament current (1V/1A)
CP15	PH-REF	Preset phototimer reference voltage (No use for MUX-100D)
CP16	GND	GND
CP17	+15V	+15V
CP18	+5V	+5V
CP19	GND	GND
CP20	VP1	Charging voltage detection (3V/100V)
CP21	VP2	Charging voltage detection (3V/100V)
CP22	IC	Charging current detection (1V/ 1A)
CP23	LV	Power supply confirmation (2V/100%) (which detects 100V output from the T1)
CP24	+15V	+15V
CP25	GND	GND
CP26	-15V	-15V
CP27	VIN	Inverter frequency voltage
CP28	MASCLK	Signal created when the TMA is converted into the frequency by the V/F converter. This signal (5 kHz/50 mA) is used in the mAs timer.
CP29	F	Oscillation frequency to drive the IGBT. This signal is adjusted by the VR2 (VFADJ). Refer to Appendix C in the Installation Manual.
CP30	mA-IN	To be short-circuited during adjustment
CP31	CHGREF	Not Use
CP32	GND	GND
CP33	A/D	IGBT drive control signal
CP34	B/C	IGBT drive control signal
CP35	KVFB-	Tube voltage feedback signal (-)
CP36	KVFB+	Tube voltage feedback signal (+)
CP37	KVT	Signal which rises when the tube voltage reaches the preset value
CP38	Q1-4	Heating FET drive control signal
CP39	EXRR	Exposure signal
CP40	Q2-3	Heating FET drive control signal

Jumper list

SW name	Silkscreen	Setup	Means
JP1	「 ON 」	○	Standard
	「 KC 」		KC signal is outputted to the terminal X2
JP2	「 C/C1 」	○	For High Voltage Trans D125PH-C/C1
	「 C2 」	×	For High Voltage Trans D125PH-C2
JP3	「 S 」	○	Master reset time Approx. 1.4 sec
	「 L 」	×	Master reset time Approx. 3.3 sec

5-3 INVERTER UNIT- C1

Function: This PCB equipped with the following circuits controls the power system.

1. IGBT circuit
2. Filament heating circuit
3. Starter circuit

During PCB replacement

Adjust the FVR again, and also confirm TkV.
As well, take care of the DIP switch setting.

Check pin list

CP No.	CP Name	Description
CP1	CL	Filament heating voltage
CP2	CO	
CP3	Gc	IGBT gate signal
CP4	Ec	
CP5	Ga	IGBT gate signal
CP6	Ea	
CP7	YC	Stator coil current detection (1V or more is normal.)
CP8	Gd	IGBT gate signal
CP9	Ed	
CP10	Gb	IGBT gate signal
CP11	ZC	Stator coil current detection (1V or more is normal.)
CP12	Eb	IGBT gate signal
CP13	GND	GND

Fuse

Fuse Name	Description
F1	Provided for protection

Dip SW

SW No.	Function
SW1-1	OFF("MUX-100" side) for MUX 100/100H/100D series
SW1-2	Not used

5-4 MUX CHARGE -04A

Function

1. Detection the battery voltage and charged voltage error.
2. Controls the battery charging current, and detects charging current error.
3. Inverter circuit for the starter and the collimator lamp.

MUX CHARGE-04A PCB has almost same function and circuit with MUX CHARGE-99 PCB, which is used for MUX-100/100H series. (However, they don't have compatibility.)
The circuit for battery charging was changed from MUX CHARGE-99 PCB, and MUX CHARGE-04A PCB uses the inverter for charging. (MUX CHARGE-99 PCB uses SSR for charging.)
The inverter itself is included in MUX CHARGE-04B PCB.

During PCB replacement

The VR1 (Lamp), the VR2 (Starter) and the VR3 (Reference frequency) should be adjusted.
Refer to Appendix C.2 of Installation Manual.
As well, confirm the detected battery charged voltage referring to "6-2-3 Confirmation of battery voltage detection".

LED list

LED No.	Signal Name	Description
LD1	CHON	Lights ON during charging the battery.
LD2	LAMP ON	Lights ON when 60Hz inverter is working ON.
LD3	STON	Lights ON when collimator lamp is selected for 60Hz inverter

VR list

Name	Function	How to adjust
VR1	Inverter pulse for Lamp	Refer to "Appendix C.2 Adjustment Method for MUX CHARGE-04A" in Installation Manual.
VR2	Inverter pulse for Starter	
VR3	Reference frequency (120Hz)	

Check pin list

CP No.	Signal Name	Description
CP1	-15V	
CP2	GND	
CP3	+15V	
CP4	VP1	Measured charged voltage 3V/ 100V
CP5	VP2	Measured charged voltage 3V/ 100V
CP6	Q2	Gate pulse for Starter and Lamp
CP7	Q1	Gate pulse for Starter and Lamp
CP8	GND	
CP9	IC	Measured charging current 1V/1A
CP10	120+	Measured charged voltage 3V/ 100V
CP11	120-	Measured charged voltage 3V/ 100V
CP12	60+	Not use
CP13	60-	Not use
CP14	50kHz	
CP15	GND	
CP16	120Hz	Reference frequency for Starter and Lamp
CP17	Lamp/Starter	Lamp/Starter change over

CP18		
CP19	LV	Line Voltage (2V/100%)
CP20	Q14C	Gate pulse for charging the battery
CP21	Q14C	Gate pulse for charging the battery
CP22	Q23C	Gate pulse for charging the battery
CP23	Q23C	Gate pulse for charging the battery
CP24	LF	4kHz pulse for 0.4A or 0.18A of setting charging current
CP25	PIC	Setting value of charging current 1V/1A
CP26	HF	26kHz pulse for 2.0A or 1.0A of setting charging current
CP27	CLK1	26kHz clock pulse for 2.0A or 1.0A of setting charging current
CP28	CLK2	4kHz clock pulse for 0.4A or 0.18A of setting charging current
CP29	Q4	Gate pulse for Starter and Lamp
CP30	Q3	Gate pulse for Starter and Lamp

Fuse list

Fuse No.	Description
F1	250V,0.5A fuse for line voltage detection circuit

5-5 MUX CHARGE –04B

Function

1. Inverter circuit for battery charging.
2. Detects the battery charging current.

During PCB replacement

No adjustment is necessary.

Check pin list

CP No.	CP Name	Description
CP1	IC2	Output for charging the battery
CP2	IC1	
CP3	Q14C	Gate pulse for charging the battery
CP4	Q23C	
CP5	IC	Measured charging current 1V/1A
CP6	+15V	
CP7	GND	

Fuse

Fuse Name	Description
F1	250V, 5.0A fuse for AC125V input power supply for charging the battery

5-6 MUX POWER-99

Function

1. Turns on and off the power, and offers the automatic power OFF function.
2. Supplies the power from the batteries to each part.
3. Change over AC /DC input for the DC pack.
4. Detects the battery voltage.

During PCB replacement

Confirm the detected battery charged voltage referring to "6-2-3 Confirmation of battery voltage detection".

Fuse list

Fuse No.	Description
F1	250V, 2.0A fuse for AC100V input power supply from the power plug for +5V, ±15V and +24V DC pack
F2	250V, 2.0A fuse for ±120V power supply from the battery for +5V, ±15V and +24V DC pack
F3	250V, 5.0A fuse for ±120V power supply from the battery for filament heating (INVERTER UNIT) and starter/collimator lamp (MUX CHARGE-04A)
F4	250V, 10A fuse for +120V power supply from the battery for DC motors (MU DRIVER-2)
F5	250V, 10A fuse for –120V power supply from the battery for DC motors (MU DRIVER-2)
F6	250V, 0.5A fuse for 12VDC power supply PS1(VAF512)
F7	250V, 5.0A fuse for charging the battery by using SSR (for MUX-100 or 100H series only)
F8	250V, 5.0A fuse for charging the battery by using SSR (for MUX-100 or 100H series only)
F9	250V, 10A fuse for power supply L,L12 from T3 transformer for collimator lamp

5-7 SHEET PANEL MUX-B

This PCB is the sheet panel for Key Switch Panel Assy.

During PCB replacement

There is no adjustment item.

5-8 SHEET PANEL MUX-100D

This PCB is the main sheet panel to operate X-ray generator.

During PCB replacement

Adjust the buzzer sound volume potentiometer.

5-9 RC RECEIVER and RC TRANSMITTER PCB (option)

Function

These PCBs are the receiving and sending side of the remote control unit option.

During PCB replacement

There is no adjustment item.

5-10 MU DRIVER-2

Function

This PCB has CPU and controls bellows.

1. Controls the DC motors.
2. Detects the handle operation.
3. Detects the bumper switch.
4. Controls the arm catch area.
5. Controls the electromagnetic lock.
6. Detects the Stop switch.
7. Detects the Emergency Brake Release switch.

Check pin list

CP No.	Signal Name	Description
CP1	GND	
CP2	-15V	
CP3	+15V	
CP4	+5V	
CP5	RIGHT CURR+	Current limit
CP6	RIGHT CURR-	Current limit
CP7	LEFT CURR-	Current limit
CP8	LEFT CURR+	Current limit
CP9	LEFT CURR+	Detection current (left) 0.1V/0.67A + 2.5V (offset)
CP10	RIGHT CURR+	Detection current (right) 0.1V/0.67A + 2.5V(offset)
CP11	R FSR	From right FSR sensor signal
CP12	L FSR	From left FSR sensor signal
CP13	120G	
CP14	-120V	
CP15	+120V	

During PCB replacement

No adjustment is necessary.

<Notice>

The right motor uses minus 120V for forward driving. and the left motor uses plus 120V for forward driving.
It is for keeping the balance between the minus and plus side voltage of the battery.

5-11 POWER 100D (LINK ASSY)

Function

This PCB is included in LINK ASSY together with the relays K21,K22 and K23 ,and controls the power ON/OFF circuit for DR system.

During PCB replacement

Set VR1 and VR2 at the middle position.

LED list

LED No.	Description
LD1	Lights ON when the switch "DR" is pressed.
LD2	Lights ON when PC for DR system is ON.
LD3	Lights ON when DC24V from XCONT-2002 PCB is available.

VR list

Name	Function	How to adjust
VR1	Output Pulse width from M1A	Pulse width should be about 2.5 sec. after the switch "DR" is pressed. Normally, set at the middle position.
VR2	Output Pulse width from M1B	Pulse width should be about 6 sec. after the switch "DR" is pressed. Normally, set at the middle position.

Check pin list

CP No.	Signal Name	Description
CP1	+24V	
CP2	+5V	
CP3	GND	

Fuse (LINK ASSY)

Fuse Name	Description
F21	250V, 2.0A fuse for +120V power supply from the battery for DR system
F22	250V, 2.0A fuse for -120V power supply from the battery for DR system
F23	250V, 0.5A fuse for AC100V power supply for the coil of relay K23

6-1 How to Remove Covers

CAUTION Make sure to set to OFF the breaker before removing the covers. Otherwise, you may get electrical shock.

6-1-1 Name and position of each cover

There is a sequence of opening/closing the covers as shown in Fig. 4.

For example, to remove the top cover, the side cover must be removed first.

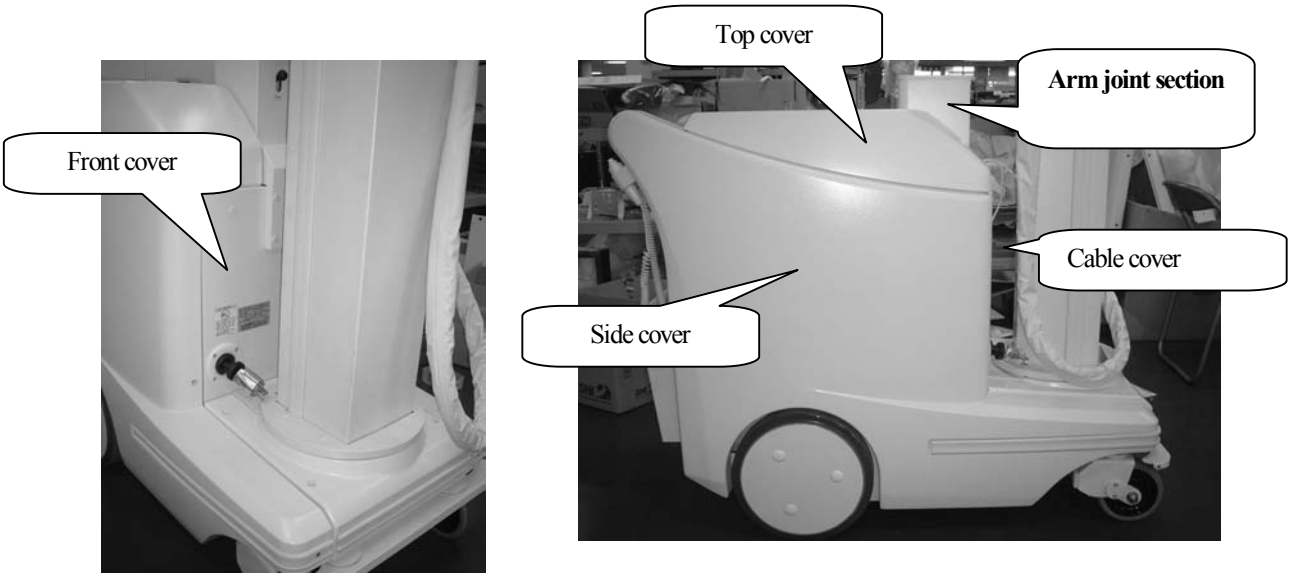


Fig. 6-1 Name of each cover and layout of the covers

6-1-2 How to remove the Side Cover

1. Take out FPD from FPD box carefully.
2. Loosen the two bolts under FPD box, then remove the four screws as shown in Fig.6-2.

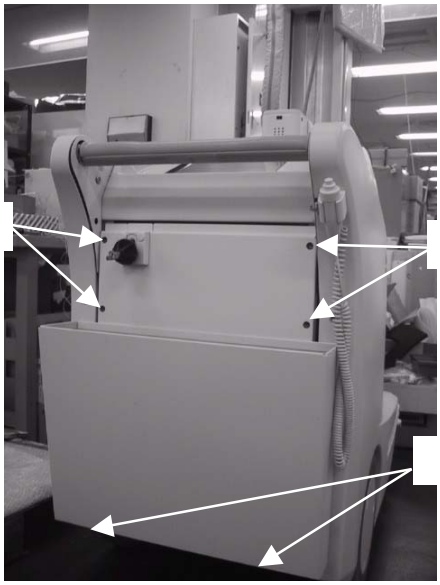


Fig. 6-2 Screw clamp positions of the FPD box

3. Pull up FPD box and remove it, then put FPD into FPD box.
4. Remove the seven screws shown in Fig. 6-3, then remove the side cover.

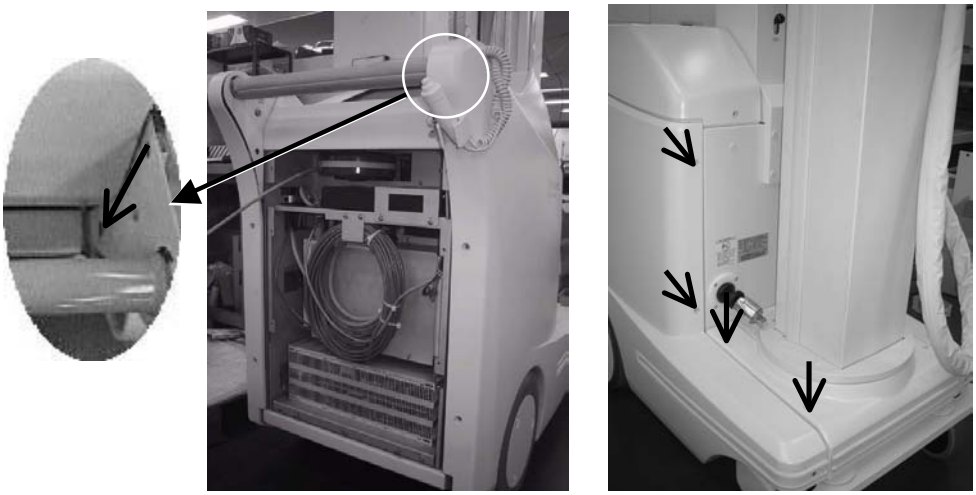


Fig. 6-3 Screw clamp positions of the side cover

CAUTION ***The right side cover and the main unit are connected with the cable of the hand switch. Be careful to remove the right side cover.***

6-1-3 How to remove the Top Cover

1. Turn the X-ray tube 180 degree around the X-ray tube stand. And move the X-ray tube to the lowest position.

   Turn off the key switch and the main breaker.

2. Unscrews the three screws as shown in Fig. 6-4.

3. Unscrews the three screws on the Top cover

4. Pull up the front part of the top cover (Fig. 6-5).

Fig. 6-4 Screw clamp positions of the top cover.

Fig. 6-5 Screw clamp positions of the top cover.

CAUTION *The top cover and the main unit are connected with the cables. Be careful to remove the top cover.*

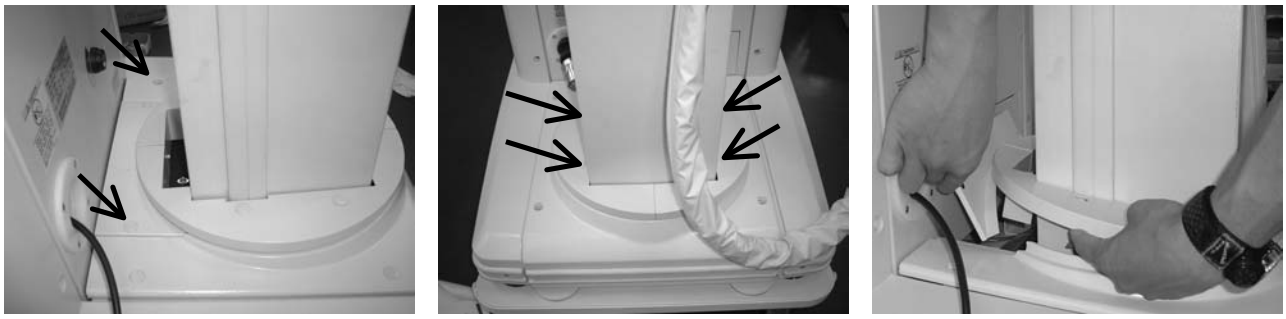
6-1-4 How to remove the Front Side Cover

1. Unscrew the 5 screws as shown in Fig. 6-6 and remove the top cover to the side of the unit.
2. Slightly holding up the column under-cover, pull out forward and remove the cover.

Fig. 6-6 Method of opening/closing the front side cover

6-1-5 How to remove the Front Rear Cover

1. Unscrew the two screws as shown in Fig. 6-6 (a).
2. Unscrew the four screws in the column under-cover as shown in Fig. 6-7 (b).
3. Remove the front rear-cover, slightly holding up the column under-cover, as shown in Fig. 6-7 (c).



(a) (b) (c)

Fig. 6-7 Method of opening/closing the front rear-cover

6-1-6 How to remove the Cable Cover

1. Unscrew the two hexagon socket head cap screws as shown in Fig.6-8.
2. Pull the cable cover upward and remove it.

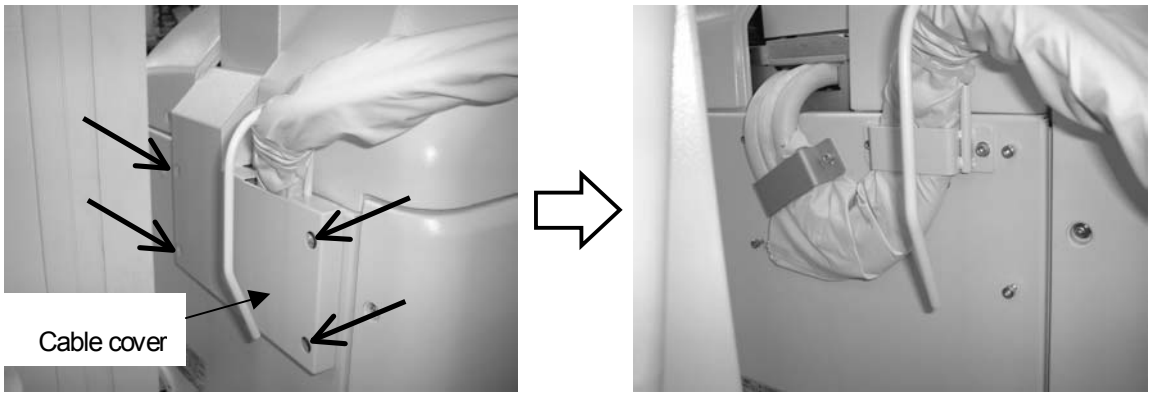


Fig. 6-8 Screw clamp positions of the cable cover

6-1-7 How to remove the Front Cover

1. Remove the front side cover and front rear cover.
2. Remove the cable cover.
3. Remove the cable guide and cable holder.
4. Remove the plug guide.
5. Unscrew the four screws as shown in Fig. 6-9 and remove the front cover.

Fig. 6-9 Screw clamp positions of the front cover

6. Remove the line switch for activating the emergency brake release function. Remove the frame of line switch from the front cover. The switch separates by blowing down the lever.

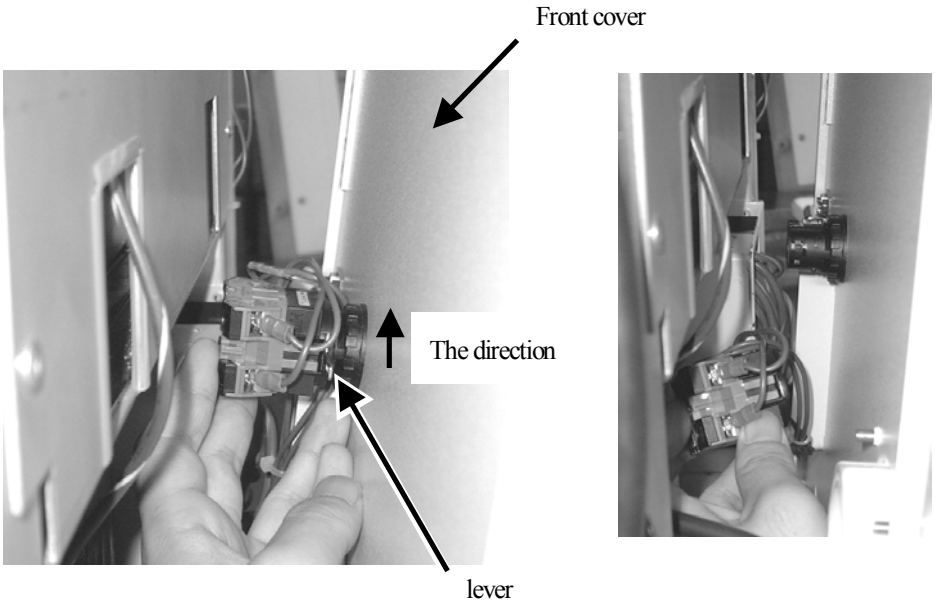


Fig. 6-10 How to remove the switch for activating the emergency brake release function.

6-1-8 How to remove the cover of Arm Joint Section

1. Remove the side covers, the upper cover and the cable cover.
2. Unscrew the hexagon socket head cap screws at the two locations indicated in Fig. 6-11.
3. Remove the knob of the arm lock release lever by turning it counterclockwise.
4. Pull out the top plate and the main cover of the arm joint section.

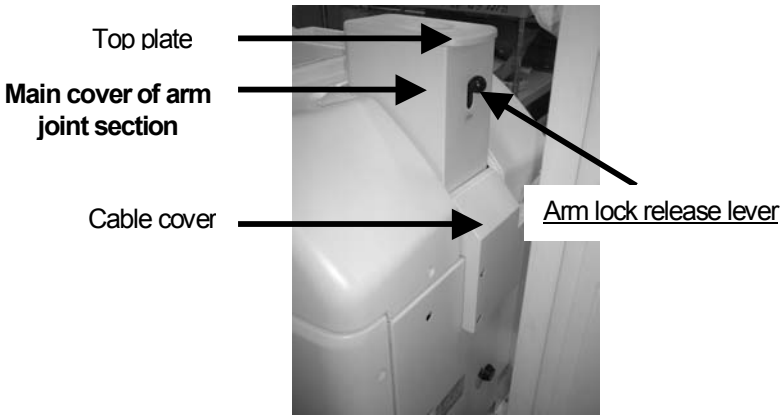


Fig. 6-11 Name of each part of the arm joint section

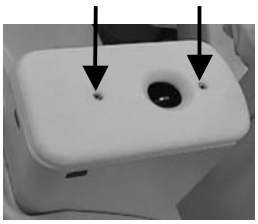


Fig. 6-12 Screw clamp positions of each cover

6-2 Battery

6-2-1 Battery specifications

By one-time charging, the system offers about 60 sets of below mentioned cycle.

1. ***Traveling 100m on the hard and straight floor***
2. ***Arm positioning with collimator lamp and one exposure with 4 mAs at 100kV with FPD (DR system CXDI-50G)***
3. ***Confirmation of the image with DR system and shut down***

The number of possible sets of exposure/traveling cycle is about 60% if you compare with MUX-100/100H because of power consumption by DR system.

6-2-2 Replacement of battery

Parts Number of the battery is 074-71014-01 (Battery,PX12090). 20 pieces are needed when replacing batteries.

WARNING

When replacing the batteries, make sure to place the unit on the flat floor. Otherwise, the unit may fall down.

WARNING

Do not wear metallic accessories such as the bracelet, hanging jewelrys, and clocks during the battery exchange work. It is very dangerous when coming in contact between terminals of the battery.

WARNING

Pay attention to polarity of +/- when arranging the battery in the battery unit. Do not short-circuit and contact between terminals.

CAUTION

The battery with a different kind, type, manufacture and residual quantity should not exist together. The device will not work properly.

(1) All 20 batteries should be replaced with new 20 batteries.
(2) 10 batteries in plus side (Battery ASSY BAT1,BAT2) should be with same date of manufacture.
(3) 10 batteries in minus side (Battery ASSY BAT3,BAT4) should be with same date of manufacture.
(4) Difference date of manufacture between plus side 10 batteries and minus side 10 batteries should be less than one month.

Date of manufacture is stamped on top of the battery.
An example of stamp is as follows.
001231## … Dec.31.2000 (## is alphabet or number which bear no relation to date of manufacture.)

Procedure of the battery exchange

1. Turn ON the key switch, and lift the arm down to the position shown in Fig. 6-13.

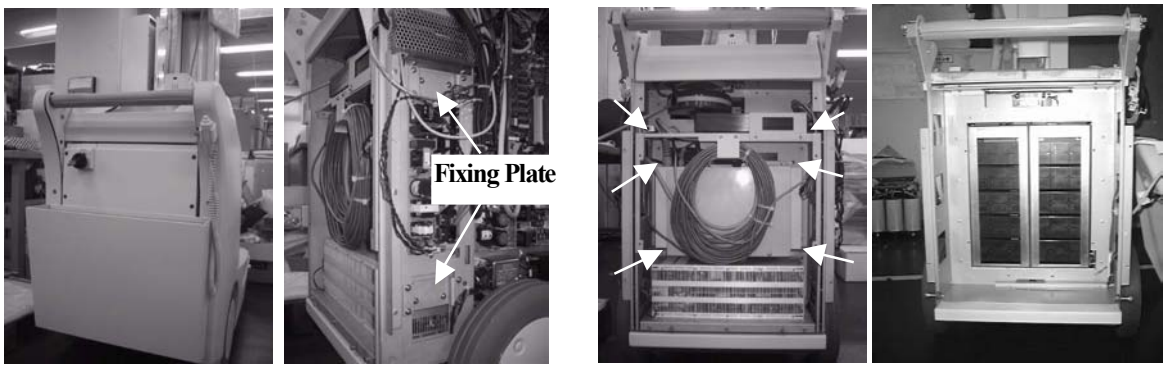
Fig. 6-13 Arm position to replace the battery

WARNING

Be sure to start replacing the battery after moving the arm down to the position shown in Fig. 6-13. Otherwise the unit may topple over when battery is replaced.

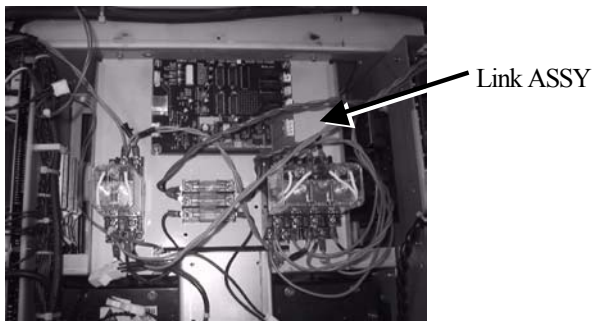
2. Turn OFF the key switch and OFF the main breaker as well.
3. Remove FPD and FPD box. (Refer to 6-1-2.)
4. Remove both of the side covers and the upper cover.(Refer to 6-1-2 and 6-1-7.)
5. Remove the Fixing Plates which are fixing DR assy to the main frame. (Refer to Fig.6-14(b).)
6. Disconnect the cable on DR assy. However, the cable between FPD and POWER BOX is not disconnected.
7. Remove the six screws as shown in Fig.6-14(C) ,pull out the DR assy.
8. Remove the Link assy above the batteries.
9. Disconnect the wires connected to the terminal block in the order (from No.1 to No.8) of the numbers shown in Fig. 6-14 (d). Be sure to disconnect them in order first from (−) terminal of BAT 2 (refer to Fig. 6-14 (d)).
10. Take out the four battery ASSY (BAT1,BAT2,BAT3,BAT4) from the main unit, and open the cover by unscrewing the flat countersunk head screw shown in Fig. 6-15, and disconnect the wiring for the battery. Take out all the batteries.

Rear view of the unit



(a) (b) (c)

Upper view of the unit



(d)

Fig. 6-14 Procedure of battery exchange

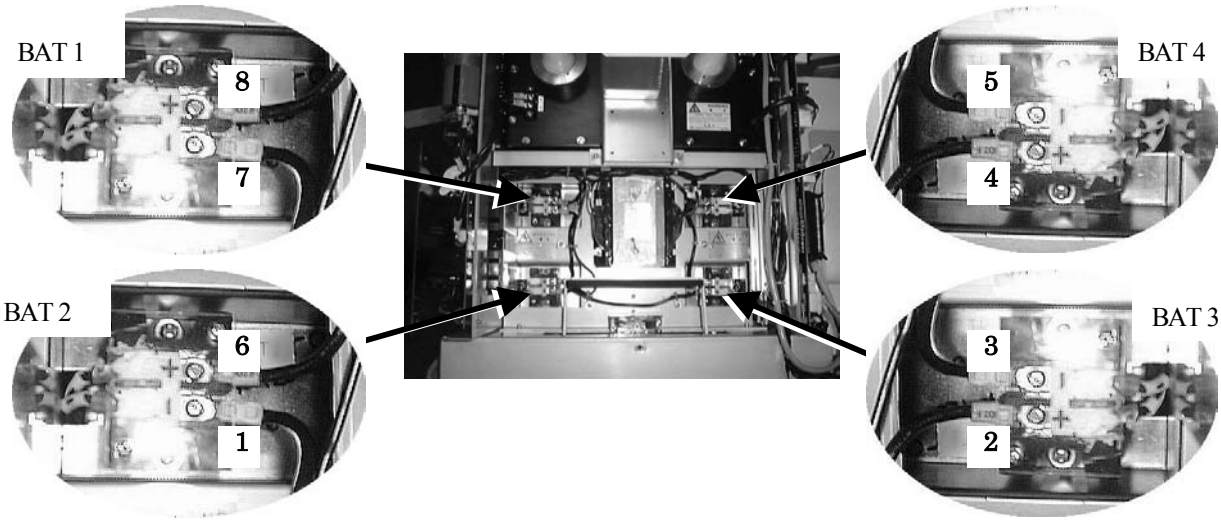


Fig. 6-15 Battery Wiring Disconnection Order

CAUTION *The weight of the battery ASSY is approximately 16 kg (1 piece). Pay rigid attention in handling it.*

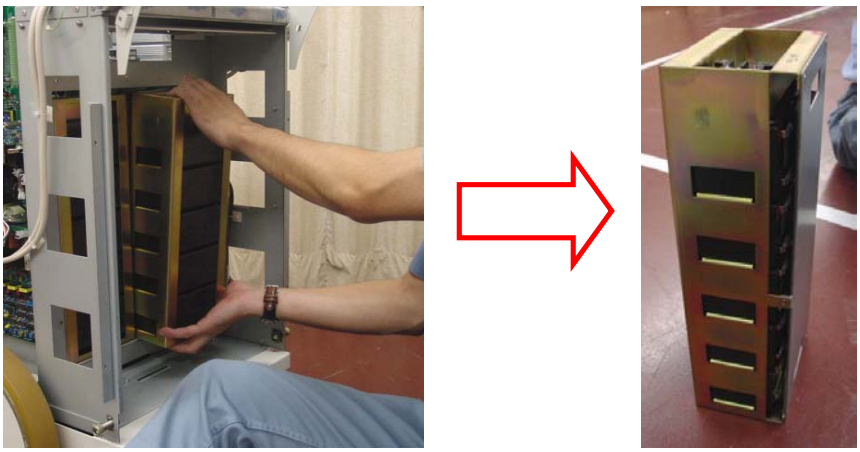
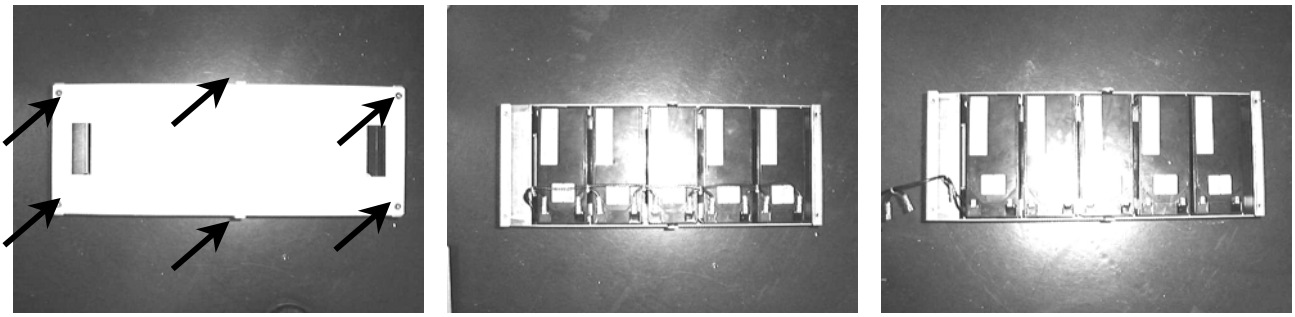


Fig. 6-16 How to Take Out the Battery ASSY



(a) (b) (c)

Fig. 6-17 Battery ASSY

In battery set BAT1,BAT3 and BAT2,BAT4 is different of structure.
The terminal block position , the battery position , and the plate are different between these two types of assembly.
They are symmetrical.

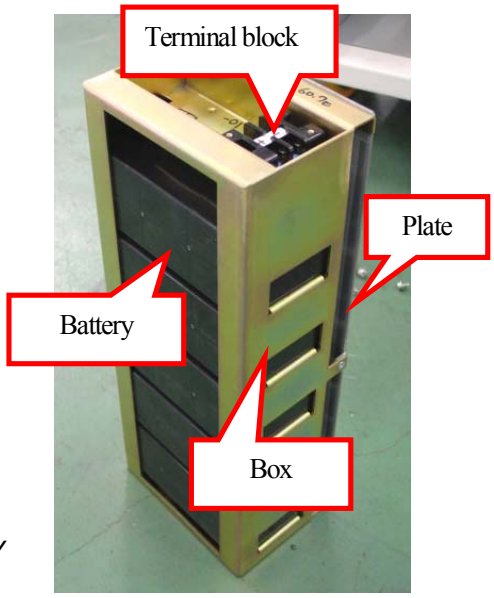


Fig. 6-18 Battery ASSY

11. Insert new batteries, and connect the wires to the electrodes. Be careful that, as for BAT2 and BAT4, their direction of battery is turned upside down.

12. Close the cover of the battery ASSY.

13. Write battery code and manufacture date of new battery in the label on top of battery ASSY.

14. Mount the battery ASSY to the original position. Pay attention to the battery numbers and positions. (Refer to Fig. 6-15.)

15. Connect the wires to the terminal block of battery ASSY in the reverse order of Fig.6-15. (from No.8 to No.1)
    Be sure to connect them in order first from (+) terminal of BAT 1 (Refer to Fig. 6-15).

16. Write the date of battery replacement in the Battery Replacement Label.

17. Mount the Link assy and connect the cables.

18. Mount the DR assy and fix it with Fix plates.

19. Mount the top cover and side cover.

20. Mount the FPD box.

21. Turn ON the main breaker, and turn ON the key switch.

6-2-3 Confirmation of Battery Voltage Detection

This adjustment is required to absorb the individual difference of the battery voltage detection circuit.
For confirmation, perform it after replacing the batteries, too.

CAUTION ***Make sure to perform this adjustment after replacing the MUX POWER , MUX CHARGE-04A or XCONT PCB, too.***

I Setting of battery voltage detection adjustment mode

Set to ON the DIP switch SW3-8 on the NEXSC PCB, and turn on the power.
Press the leg scan key in the APR to enter the + side battery voltage adjustment mode. Press the foot scan key in the APR to enter the - side battery voltage adjustment mode. In each mode, the converted detected voltage is displayed in 6 digits in the tube voltage and current time product display units.
(The LED on the leg or foot scan key flickers.)

II Adjustment of battery voltage

Measure the battery voltage, make the error between the measured value and the displayed value to ±0.2V or less using the tube current time product setting keys "+" or "-" key. Then, press the program registration key.

Battery voltage on the + side : Measured between TER3 and TER5 on the MUX POWER PCB
Battery voltage on the – side : Measured between TER5 and TER4 on the MUX POWER PCB

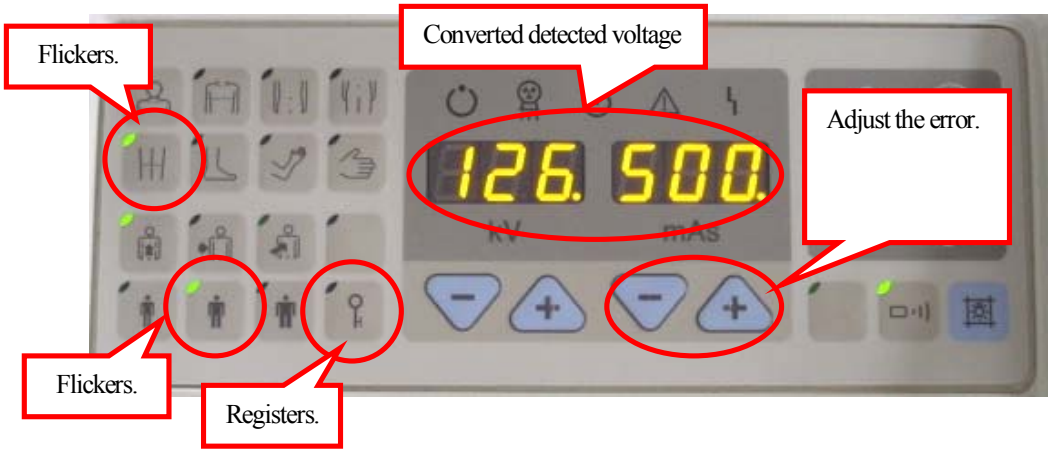


Fig. 6-19 Panel when the Detected Battery Voltage is Adjusted (on the + Side)

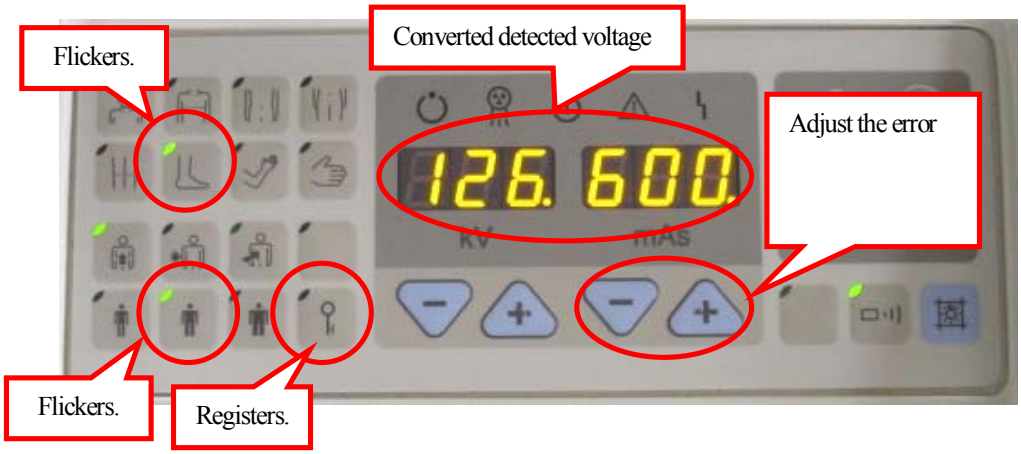


Fig. 6-20 Panel when the Detected Battery Voltage is Adjusted (on the - Side)

6-3 Replacement of X-ray Tube

WARNING ***Make sure to set to OFF the main breaker before starting the work.***

6-3-1 Replacement of X-ray tube

Replace the X-ray tube using the procedure below.

1. At first, set the tube (arm) to the position shown in Fig. 6-21, and fix it with bolts (M8 or M12×40). (Fix the internal weight.)

WARNING ***Make sure to fix the weight before replacing the X-ray tube. Otherwise, the system may become unbalanced , leading to unexpected accidents.***

Fig. 6-21 Fixing the Weight

2. Remove the collimator from the rotation unit mounted in the tube. Put the removed collimator on cushion on the main unit or a base.

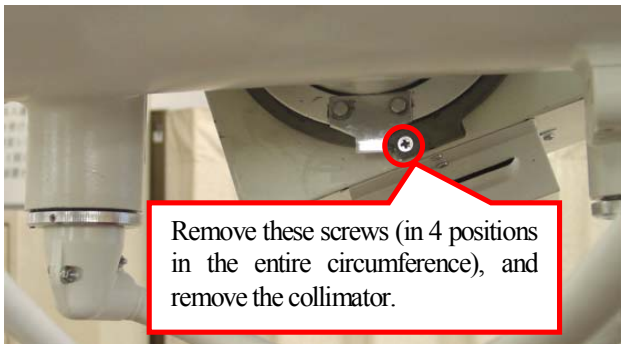


Fig. 6-22 Removing the Collimator

3. Disconnect the high voltage cable from the plug area. Disconnect the low voltage cable from the connector relay area under the arm. At this time, in disconnecting the high voltage cable, loosen the ring rotation stopper (set screws in 4 positions). It is recommended for easier work to remove also the angle bending the high voltage cable.
(If this angle remains attached, it is difficult to connect the high voltage cable to the plug.)

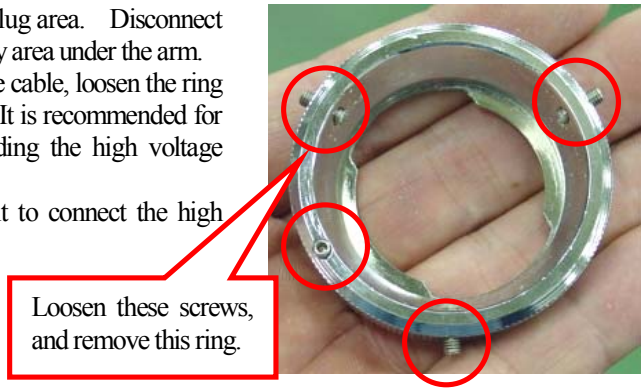


Fig. 6-23 High Voltage Cable Fixing Ring

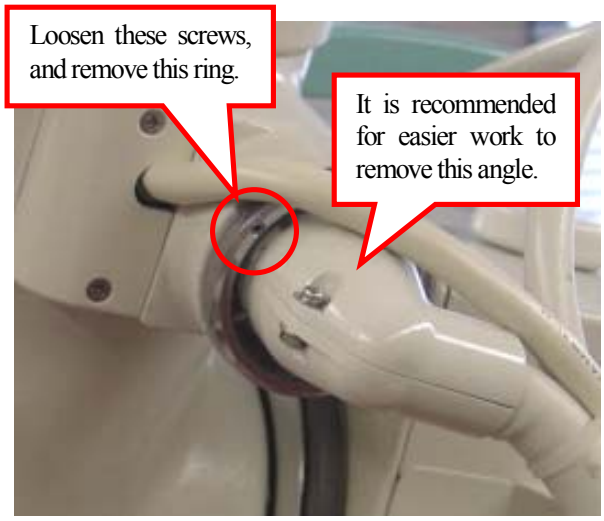


Fig. 6-24 Disconnecting the High Voltage Cable

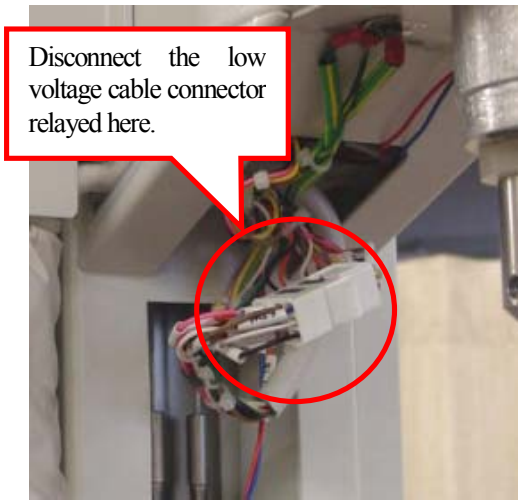


Fig. 6-25 Connector Relay Area

4. Remove the cover from the tube rotation unit attaching the tube to the arm, remove socket head cap screws (in 4 positions on each of the left and right sides) inside, then remove and move down the tube from the holding frame.

CAUTION ***The weight of the tube ASSY is approximately 13 kg. Pay rigid attention in moving it down from the arm.***

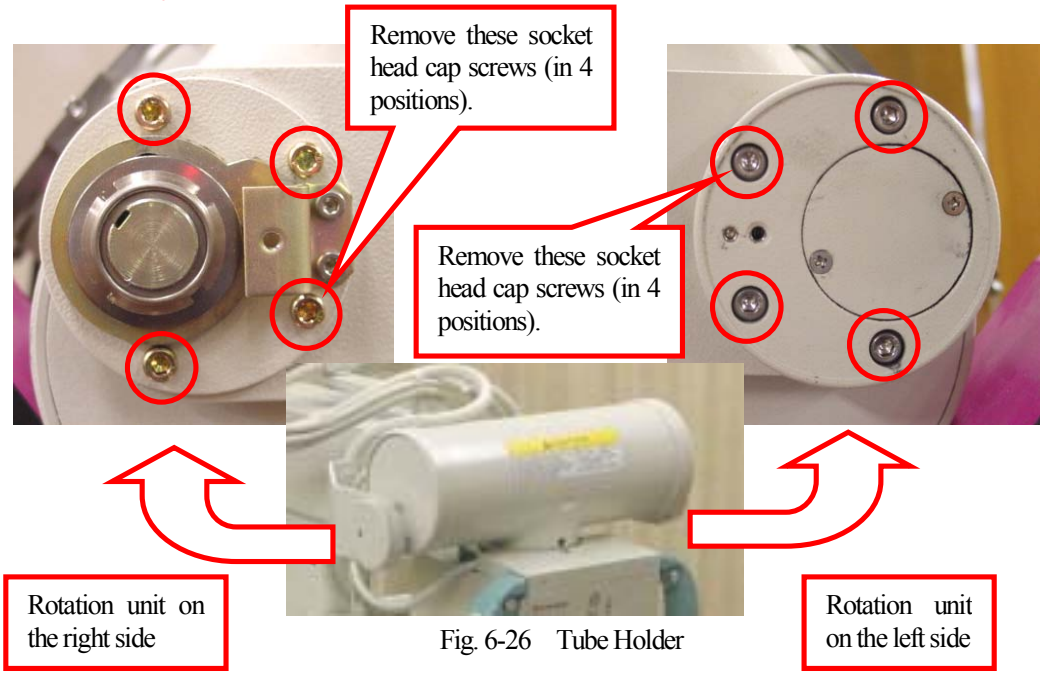


Fig. 6-26 Tube Holder

5. Remove the left and right tube rotation units from the tube.
As to the right side, loosen the U nut (new type lock nut not requiring a inner clip washer) in the center, then remove the rotation stopper, the spring washer, etc. After that, remove socket head cap screws from the shaft area, then remove the shaft area.
As to the left side, remove the cover (countersunk head screws in 2 positions), then remove socket head cap screws from the inside.

CAUTION ***Grease will be applied on sliding units at the end. Every time removing each part, clean the sliding units. Moreover, please be sure to decompose at the time of decomposition work, performing marking so that an attachment position and a direction may be known from back. It mistakes, and when assembling, it may not operate normally.***

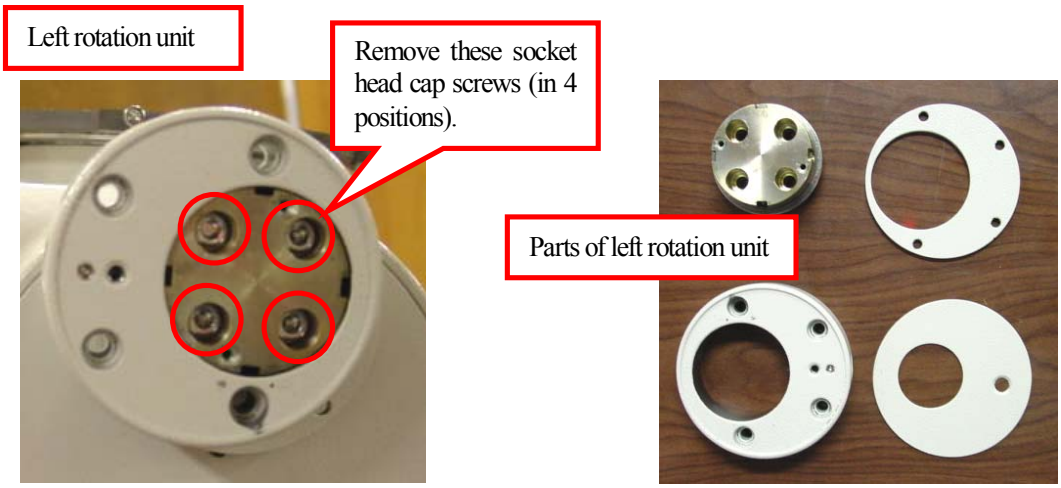


Fig. 6-27 Removing the Left Rotation Unit and Removed Parts

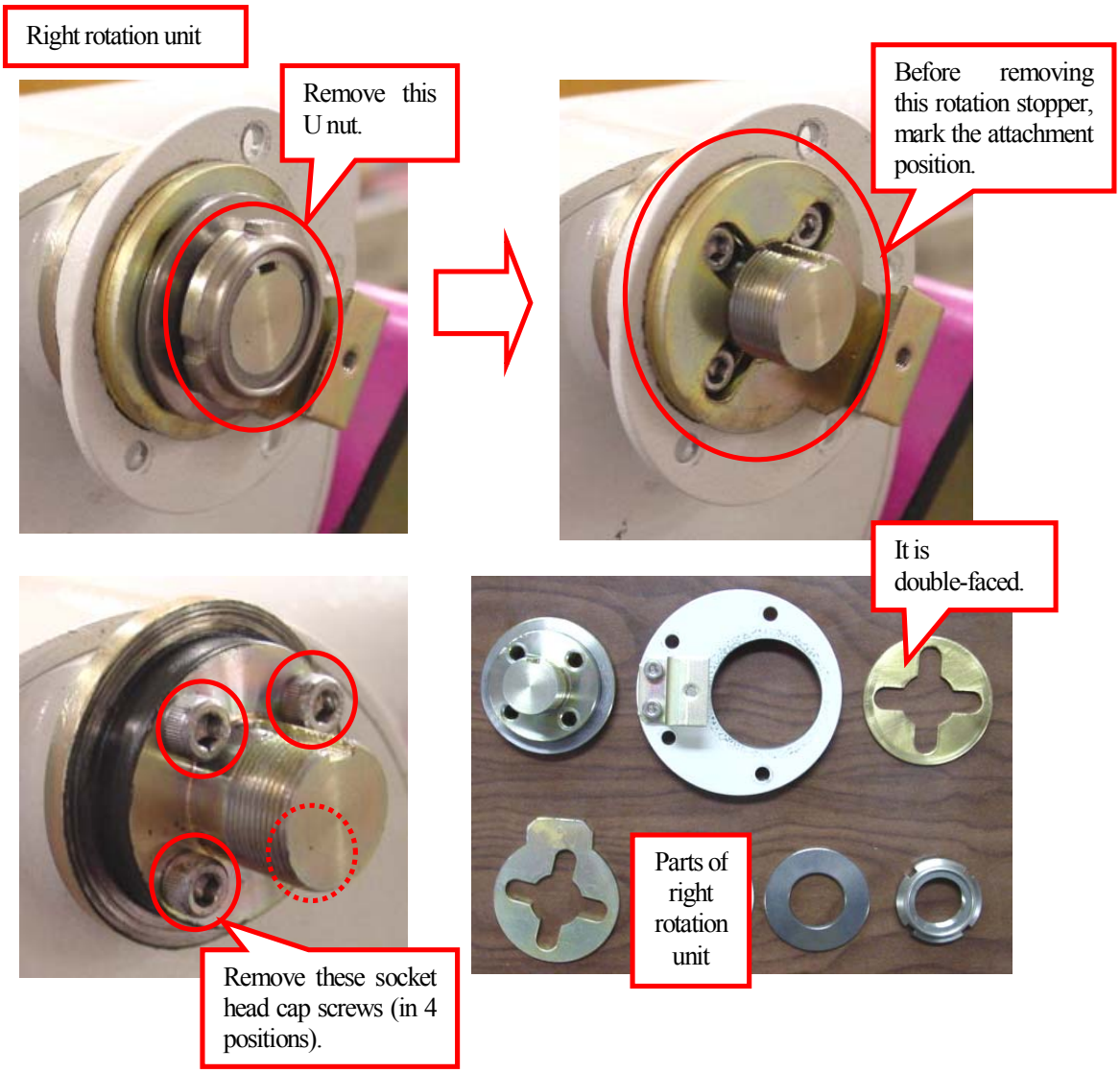


Fig. 6-28 Removing the Right Rotation Unit and Removed Parts

6. Remove the collimator rotation unit, and attach it to a new tube. Please be careful in the direction of stopper at this time.

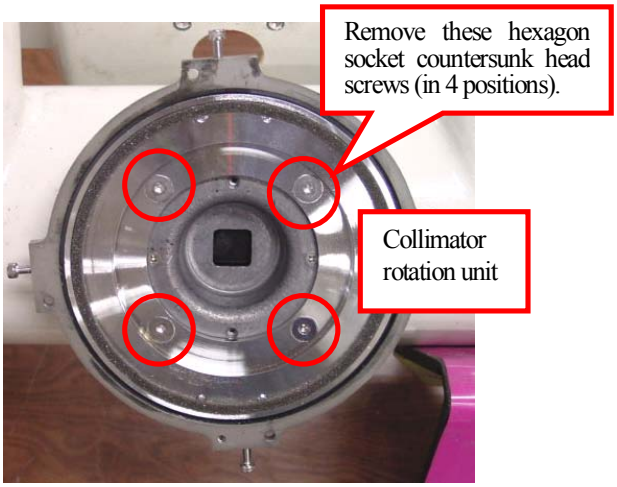


Fig. 6-29 Removing the Collimator Rotation Unit

7. Attach the left and right rotation units to the new tube in the order of removal. At this time, clean the sliding units, and apply grease on the following portions before attachment.

CAUTION ***Make sure to use grease not containing abrasive.***
Recommended grease: Albania grease 2 (Showa Shell)

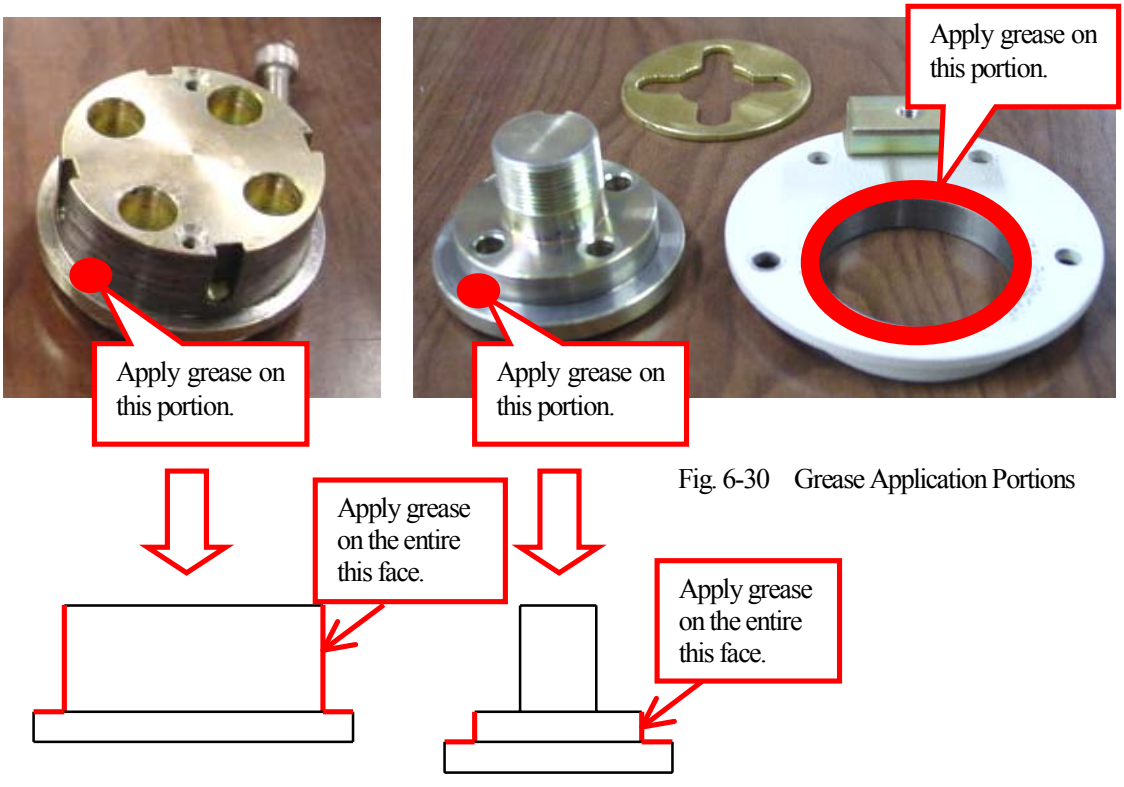


Fig. 6-30 Grease Application Portions

8. At the end, attach the low voltage cable, the collimator and the high voltage plug, and treat the cables. At this time, attach the high voltage plug using the following procedure.

REFERENCE *The following kit is offered as high voltage cable repair parts. Use it upon necessity. In stock [in each office / more than one].*

511-15061-13: Mini plug maintenance kit
Silicon rubber jacket, silicon washer and silicon oil (5 each)

i Make sure that the inside of the socket in the X-ray tube unit is not dirty.
ii Make sure that the plug and the ring nut are not dirty.
(For the name of each part, refer to Fig. 6-31.)
iii Let the ring flange go through the ring nut.
iv Apply silicon oil on the silicon rubber jacket and the silicon washer.
v Fit the silicon washer into the tip of the plug.
vi Put the plug into the socket. When the plug tip reaches the bottom of the socket, turn the plug to find the position in which the plug is fitted into the key way, then push the plug.
vii Tighten the ring nut with hand.
viii Tighten the rotation stopper screw so that the ring nut does not rotate.

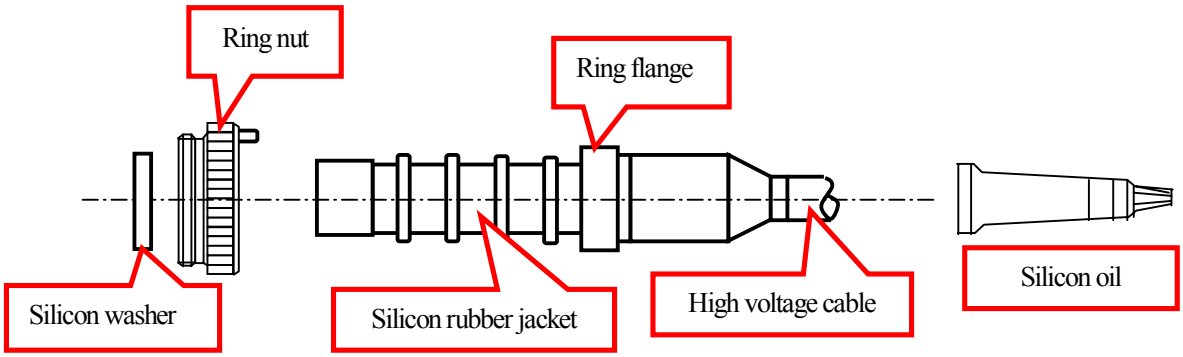


Fig. 6-31 High Voltage Plug

Fig. 6-33 Cable Treatment (Reference Drawing)

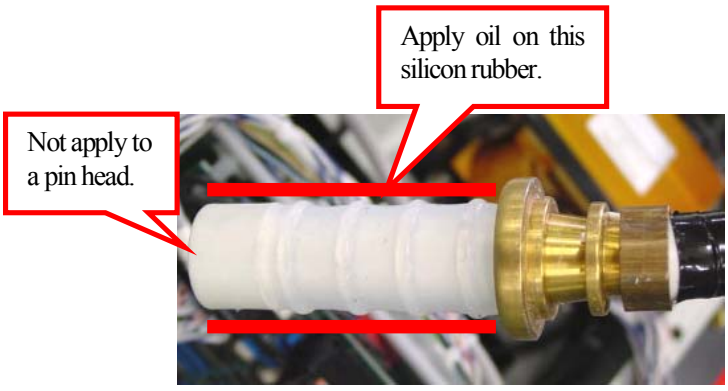


Fig. 6-32 High Voltage Plug (Oil Application Position)

6-3-2 Adjustment after replacement of X-ray tube

After replacing the X-ray tube, perform aging in accordance with "I Aging" in 4-1-6.
Then, adjust the FVR (preset value of filament current) in accordance with "6.4 Adjustment of Tube Current".

6-4 Adjustment of Tube Current

Adjust the tube current by changing the preset value of the filament current (hereafter referred to as "FVR value"). Usually, adjust the tube current in the tube current 2-point adjustment mode. If adjustment of higher precision is required, adjust the tube current in the tube current each point adjustment mode.

NOTE ***After changing the FVR value, if you turn off the power or change position or change mode without pressing the program registration key, the FVR value is not stored. Registration is enabled even while the scan condition is displayed (that is, while the FVR value is not displayed.)***

6-4-1 FVR adjustment in tube current 2-point adjustment mode

I Setting of tube current 2-point adjustment mode

Set to ON the DIP switch SW2-5 (Measured value display mode) SW3-8 (Adjustment mode) on the NEXSC PCB, and turn on the power.

Press the head scan key in the APR to enter the tube current 2-point adjustment mode. (The LEDs on the head scan key and the standard body key flicker.)

II Setting of tube voltage

(Because the tube voltage is fixed to 80 kV, you do not have to set it.)

III Setting of tube current

Only two positions, 50 and 160 mA, can be set. Set each position, then perform the steps IV and VI.

IV Exposure

Press the hand switch to perform exposure. When the measured tube current is displayed in the tube current display unit, compare it with the preset value.

V Adjustment of FVR value

Press the remote control selection key to display the FVR value in the preset tube voltage display unit. To change the FVR value, press the tube voltage setting keys. If the measured tube current is higher than the preset value, make the FVR value smaller. If the measured tube current is lower than the preset value, make the FVR value larger. Repeat the steps IV and VI until the measured value becomes proper (50 mA : 45 - 48mA 160mA : 148 – 155 mA).

VI Registration of FVR value

Press the program registration key to register the FVR value in each position. When this key is pressed, "record" is displayed in the display unit and the FVR value is stored.

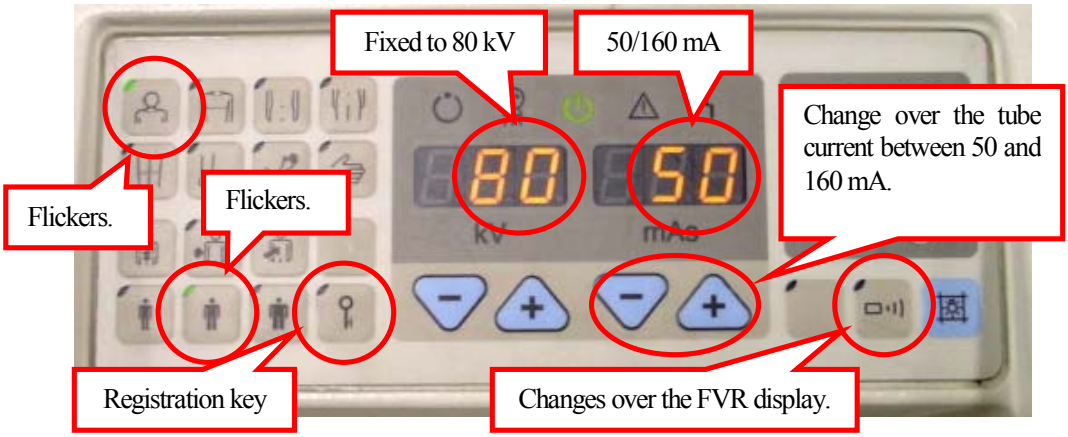
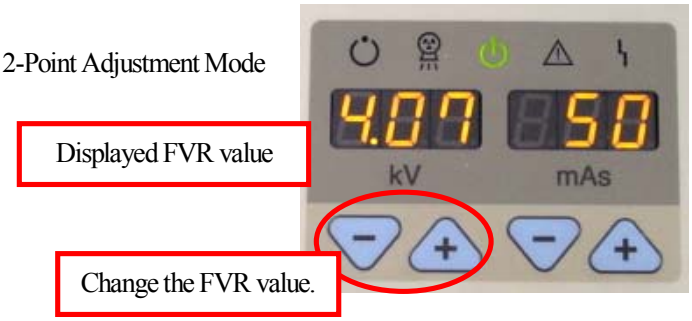


Fig. 6-34 Panel in the Tube Current 2-Point Adjustment Mode



6-4-2 FVR adjustment in tube current each point adjustment mode

I ***Setting of tube current each point adjustment mode***

Set to ON the DIP switch SW2-5 (Measured value display mode) SW3-8 (Adjustment mode) on the NEXSC PCB, and turn on the power.
Press the chest scan key in the APR to enter the tube current each point adjustment mode.
(The LEDs on the chest scan key and the standard body key flicker.)

II ***Setting of tube voltage***

Set the tube voltage to 40, 60, 80, 100 and 125V in turn, and perform the steps III to VI for each tube voltage.

III ***Setting of tube current***

Set the tube current to 50, 63, 80, 100, 125 and 160 mA in turn, and perform the steps IV to VI for each tube current.

IV ***Exposure***

Press the hand switch to perform exposure. When the measured tube current is displayed in the tube current display unit, compare it with the preset value.

V ***Adjustment of FVR value***

Press the remote control selection key to display the FVR value in the preset tube voltage display unit. To change the FVR value, press the tube voltage setting keys. If the measured tube current is higher than the preset value, make the FVR value smaller. If the measured tube current is lower than the preset value, make the FVR value larger. Repeat the steps IV and VI until the measured value becomes survey value (-15 % to +5 %) .

VI ***Registration of FVR value***

Press the program registration key to register the FVR value in each position. When this key is pressed, "record" is displayed in the display unit and the FVR value is stored.

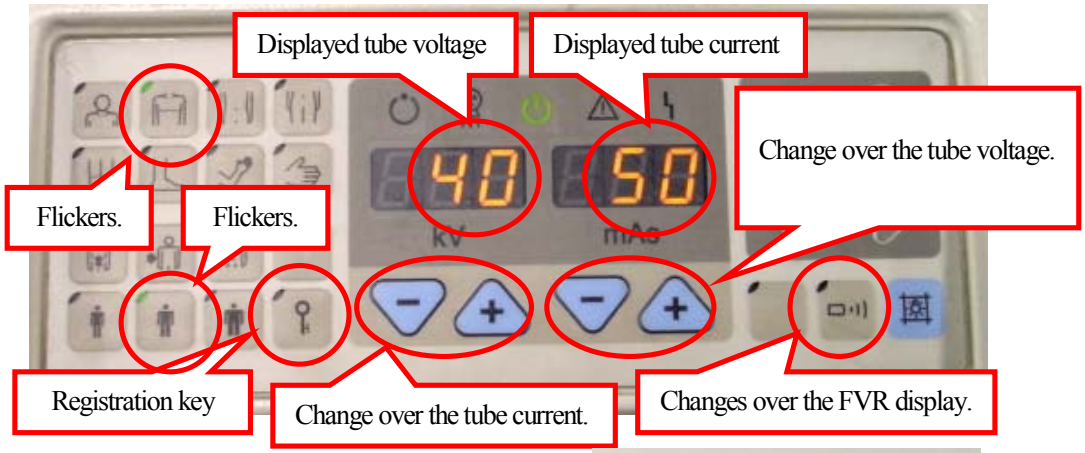
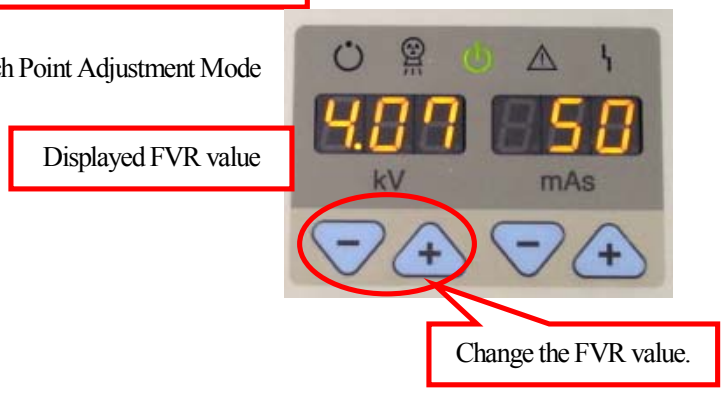


Fig. 6-35 Panel in the Tube Current Each Point Adjustment Mode



6-4-3 Initialization of FVR value

Press and hold the thin body key (one of the body thickness correction keys) until "cancel" is displayed (for approximately 3 seconds).

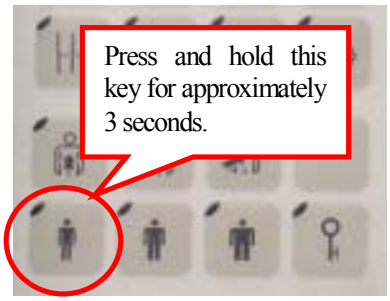


Fig. 6-36 How to Initialize the FVR Value

NOTE *The FVR value can be initialized in initialization of the NEXSC PCB. In this case, however, other data (such as APR) is initialized at the same time.*

6-5 Replacement of Collimator Lamp

Replace the collimator lamp using the following procedure.

CAUTION *Never touch directly the collimator lamp. If dirt is adhered on the lamp, the illuminance may be deteriorated.*

NOTE *After the power of the system has been OFF for a while or after a while after the key switch was set to OFF (that is, after the collimator lamp is cooled down), replace the collimator lamp.*

1. Remove the lamp outer cover of the collimator.
2. Remove the lamp cover.
3. Replace the lamp **(P/N 062-65003-02 halogen lamp)**.
4. Attach the covers again.

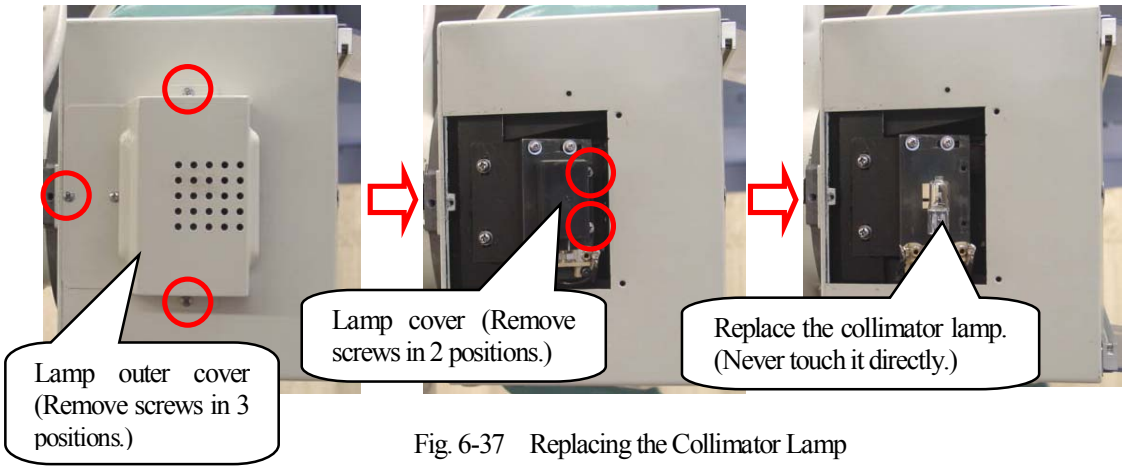


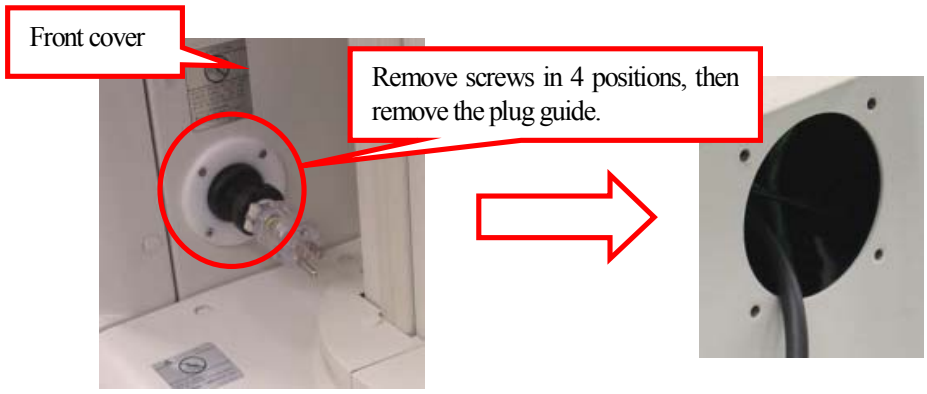
Fig. 6-37 Replacing the Collimator Lamp

6-6 Replacement of Cord Reel

Replace the cord reel using the following procedure.

WARNING ***Make sure to set to OFF the main breaker before starting the work.***

1. At first, remove the plug guide (made of resin).
2. Next, remove the right side cover referring to 6-1-2 and the front cover referring to 6-1-7.
3. Disconnect the cord reel wiring (AC line and ground).
4. Remove the hexagon socket head cap screw on your side, and pull out the cord reel.
5. Remove the spacer (mounting bracket) from the old cord reel, and attach it to a new cord reel.
   (P/N 503-49045 cord reel wiring diagram ASSY … Wiring is completed.)
   (P/N 071-58101-02 cord reel EFT160A.4kk … cable reel only)
6. Attach the new cable reel in the same position, return the wiring, attach the covers again, then attach the plug guide at the end.



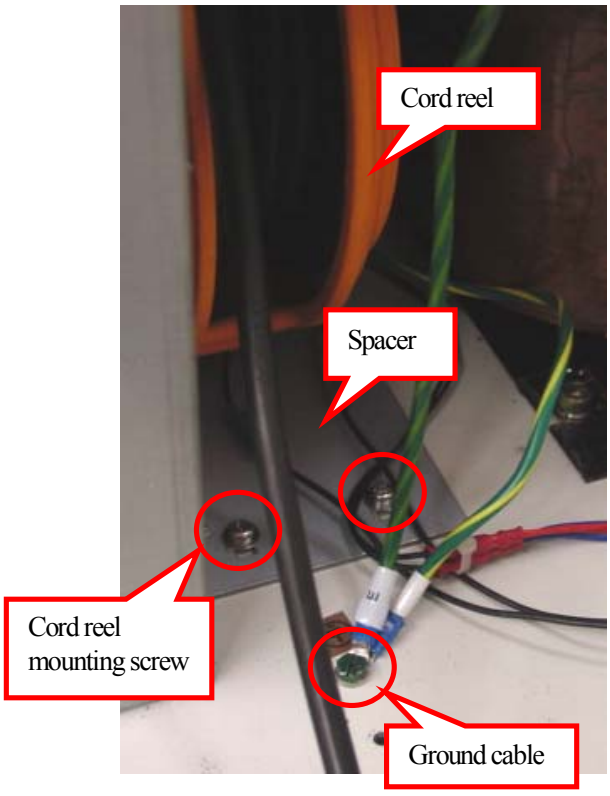


Fig. 6-38 How to Remove the Cord Reel

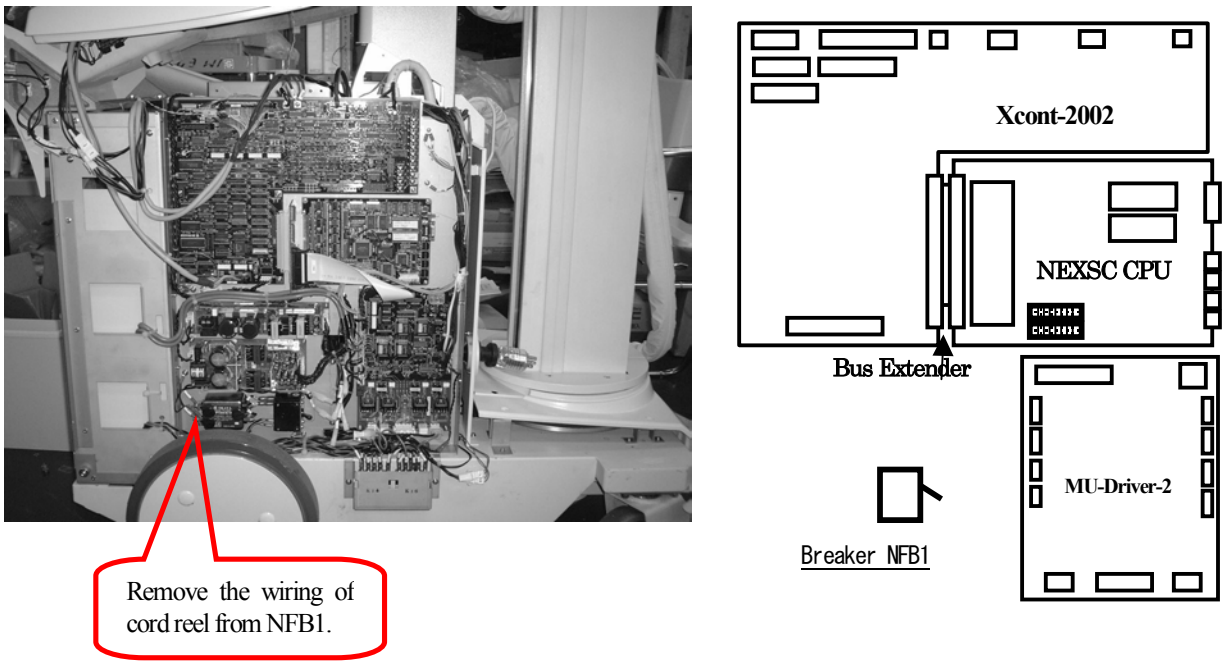


Fig. 6-39 How to Remove the Wiring of Cord Reel

6-7 Replacement of IGBT

Replace the IGBT using the following procedure.

WARNING ***Make sure to set to OFF the main breaker before starting the work.***

1. Remove the left side cover.
2. Remove the PCB cover.
3. Remove the fasten terminal of the gate emitter connected to the IGBT.
4. Remove screws (in 3 positions) from the PCB, remove the IGBT, then replace it with a new one. **(P/N 060-39940-1 TR, 2MB1300M-060)**
5. Connect the fasten terminal again.
6. Confirm and adjust IGBT gate waveform referring to C.3 "Adjusting XCONT 2002 board".
8. Attach the PCB cover again.

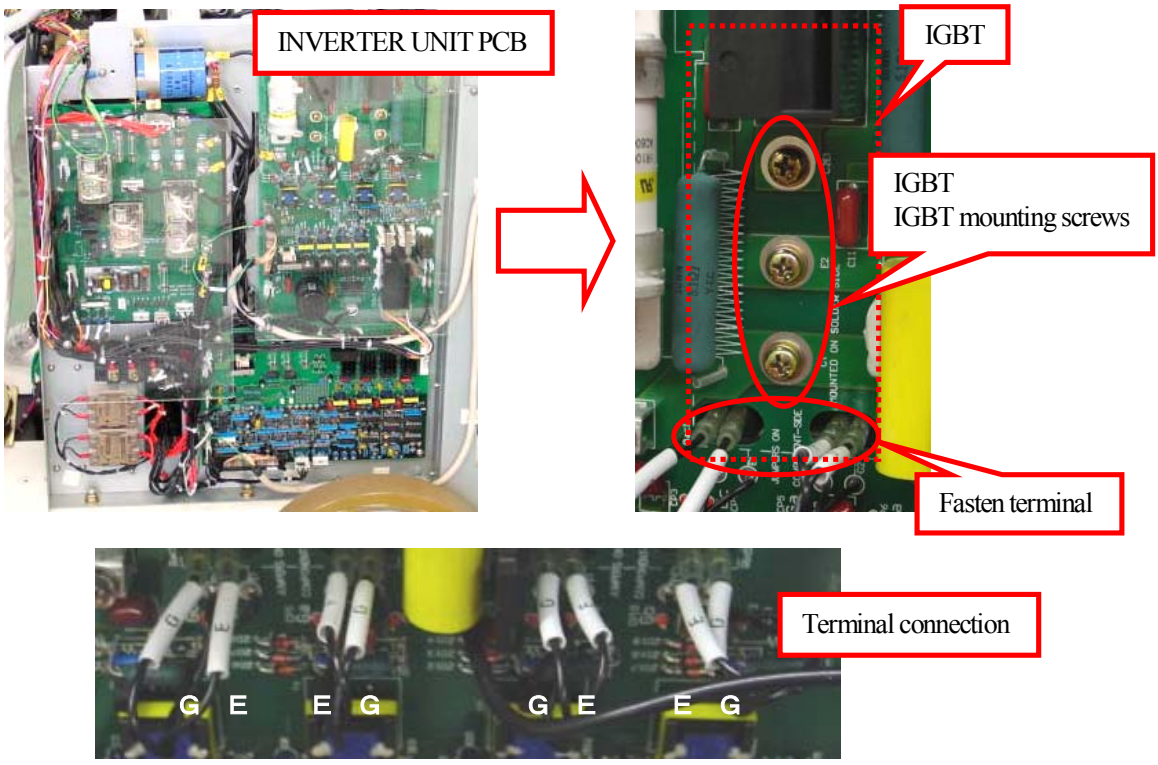


Fig. 6-40 Replacing the IGBT

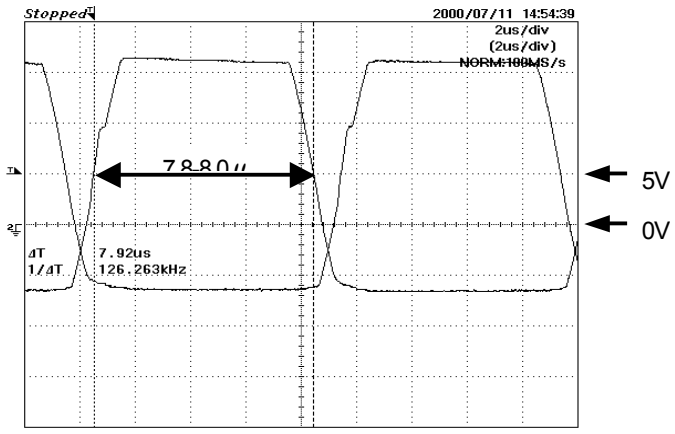


Fig. 6-41 Confirmation of IGBT Gate Waveform

6-8 Setting of Date and Time

Set the date (year, month and day) and the time.

Ⅰ Setting of date/time setting mode

Set to ON the DIP switch SW3-8 on the NEXSC PCB, and turn on the power.
Next, press the hand scan key in the APR to enter the date/time setting mode.
(The LEDs on the hand scan key and the standard body key flicker.)

Ⅱ Confirmation of date change

Press the remote control selection key to display the date (year, month and day). (The LED on the key is extinguished.)
Change the year (the last two digits of the year) using the tube voltage setting keys "+" "-".
Change the month using the tube current time product setting key "-".
Change the day using the tube current time product setting key "+".

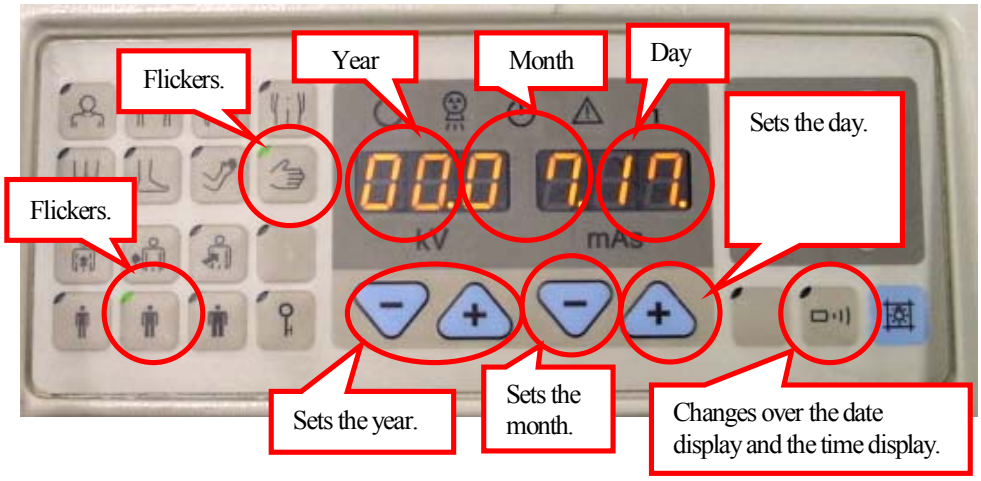


Fig. 6-42 Panel when the Date is Set

Ⅲ Change of time

Press the remote control selection key to display the time. (The LED the key flickers.)
Change the time using the tube voltage setting keys "+" "-" (24-hour display).
Change the hour using the tube voltage setting key "+" "-".
Change the minute using the tube current time product setting keys "+" "-".

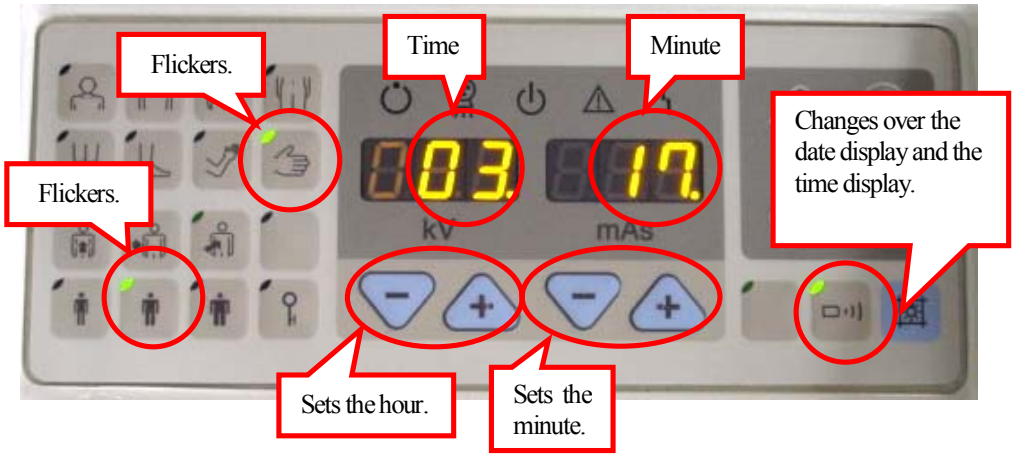


Fig. 6-43 Panel when the Time is Set

6-9 Display and Reset of Exposure Counter

The number of times of exposure controlled by the software can be displayed and reset.

Ⅰ Setting of exposure counter mode

Set to ON the DIP switch SW3-8 on the NEXSC PCB, and turn on the power.
Next, press the thick body key and the head scan key in the APR to enter the exposure counter mode.
(The LEDs on the head scan key and the thick body key flicker.)

Ⅱ Confirmation of accumulated number of times

The accumulated number of times is displayed in the preset tube voltage display unit and the tube current time product display unit.

Ⅲ Reset of accumulated number of times

Press and hold the program registration key for approximately 3 seconds to reset the displayed accumulated number of times to 0.

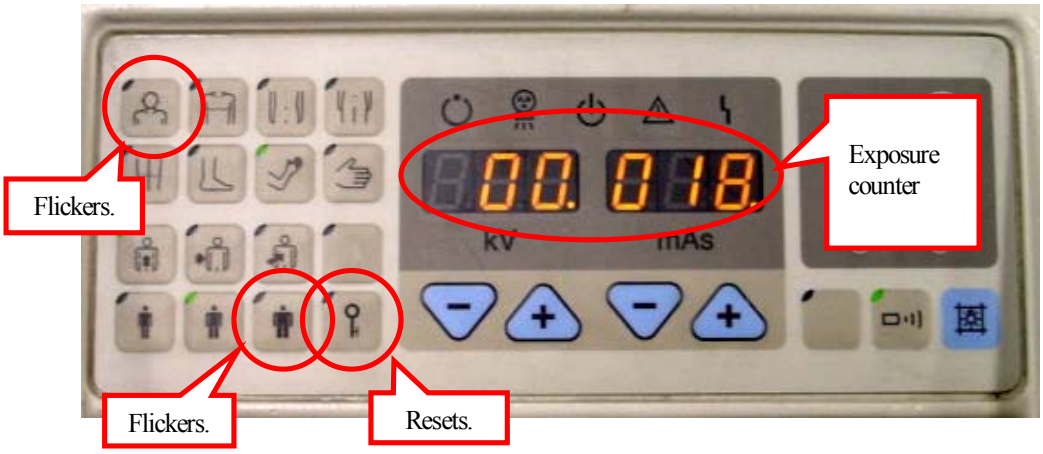


Fig. 6-44 Panel when the Exposure Counter is Displayed

6-10 Display and Reset of Accumulated Travel Distance

The accumulated travel distance controlled by the software can be displayed and reset.

Ⅰ Setting of accumulated travel distance mode

Set to ON the DIP switch SW3-8 on the NEXSC PCB, and turn on the power.
Next, press the thick body key and the chest scan key in the APR to enter the accumulated travel distance mode. (The LEDs on the thick body key and the chest scan key flicker.)

Ⅱ Confirmation of accumulated distance

Every time the remote control key is pressed, the remote control key lamp flickers or becomes extinguished. While the lamp is flickering, the total accumulated travel distance is displayed. While the lamp is extinguished, the relative accumulated travel distance is displayed.
The total accumulated travel distance indicates the accumulated travel distance from the time of shipment from the factory. The relative accumulated travel distance indicates the accumulated travel distance from the previous reset. The unit is km.

Ⅲ Reset of accumulated travel distance

Press and hold the program registration key for approximately 3 seconds to reset the displayed accumulated travel distance to 0.

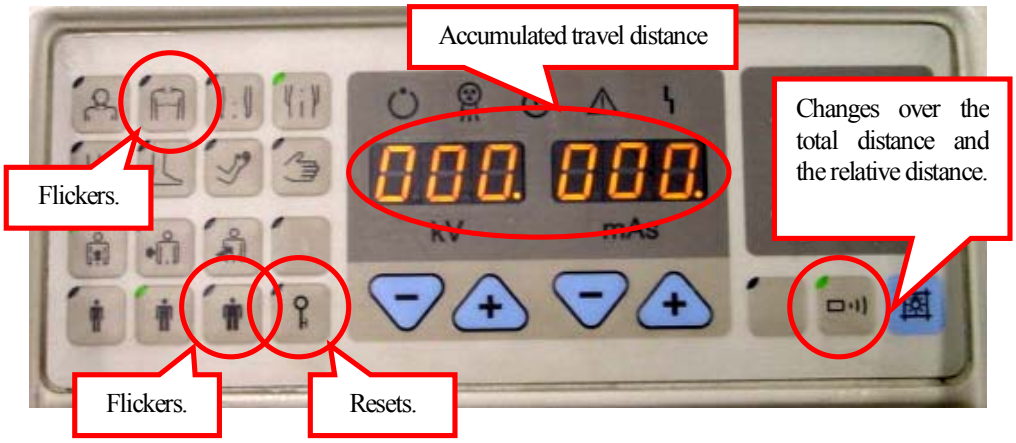


Fig. 6-45 Panel when the Accumulated Travel Distance is Displayed

NOTE ***During installation, make sure to confirm the displayed distance. If an improper value (for example, a value indicating that the system has traveled for many km) is displayed, make sure to reset the travel distance.***

6-11 Display and Reset of Error Log

Up to 32 error codes which have occurred so far can be displayed and reset.

Ⅰ Setting of error log display mode

Set to ON the DIP switch SW3-8 on the NEXSC PCB, and turn on the power.
Next, press the thick body key and the abdomen scan key in the APR to enter the error log display mode.
(The LEDs on the thick body key and the abdomen scan key flicker.)

Ⅱ Confirmation of contents of error log

The log No. is displayed in the kV display unit. The type of error is displayed in the mAs display unit. The log Nos. are 000 (newest log) to 031 (oldest log). Change the log No. using the tube voltage setting keys "+" or "-" key.

Ⅲ Reset of error log

Press and hold the program registration key for approximately 3 seconds to reset the error log currently stored.

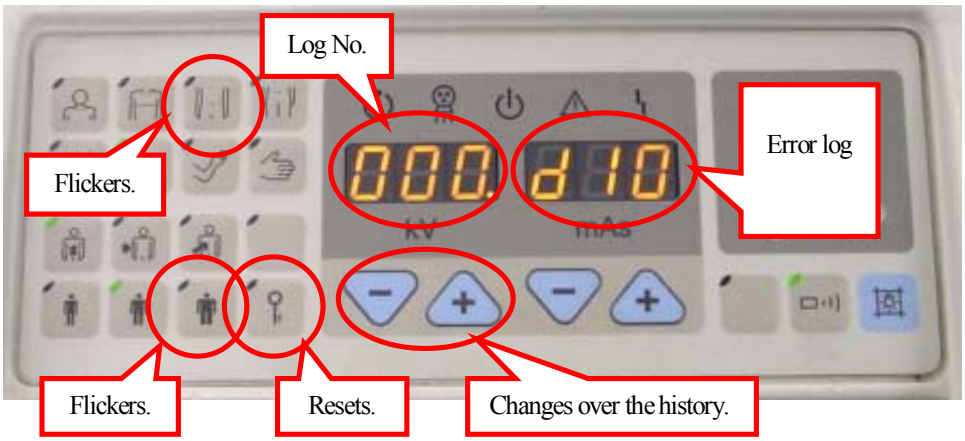


Fig. 6-46 Panel when the Error log is Displayed

6-12 Replacement of CPU Backup Battery on NEXSC PCB

Replace the CPU backup battery on the NEXSC PCB using the following procedure.

1. Remove the right side cover from the control unit.
2. Set the key switch to ON.
3. Disconnect the battery on the NEXSC PCB from the connector, and connect a new battery.
   (P/N 501-78646 CPU backup battery)
4. Attach the cover again.

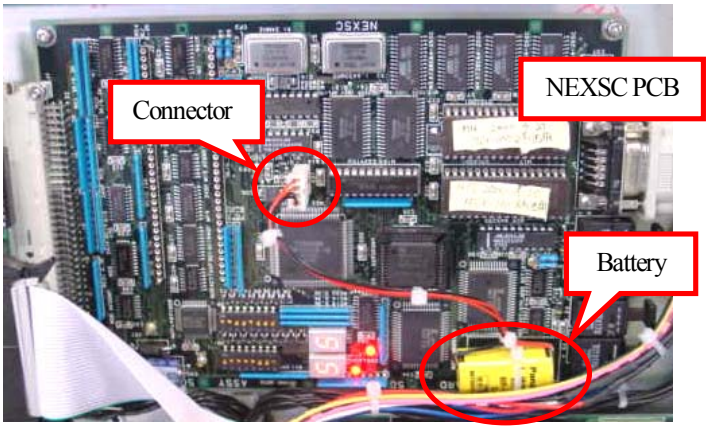


Fig. 6-47 How to Replace the CPU Backup Battery on the NEXSC PCB

6-13 Adjustment of Micro Switch for Arm Retraction Detection

In arm joint section, there are two switches.

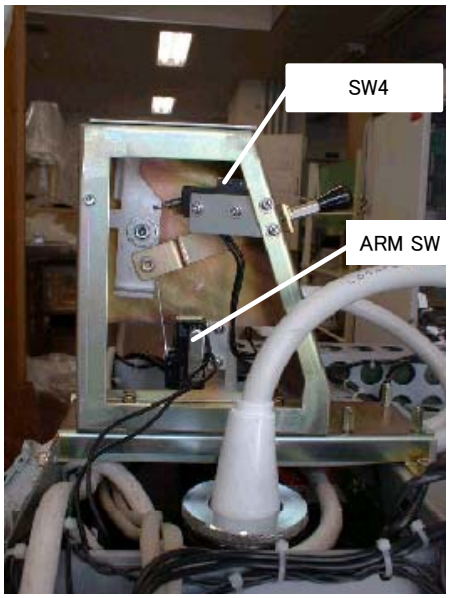


Fig. 6-48

SW4 should be always ON when arm is hold.
Otherwise, the driving speed of DC motors for traveling cannot be high speed.
If it becomes OFF during high speed driving, the driving speed suddenly becomes low speed.
If there is such kinds of driving trouble, adjust SW4 referring to below procedure.

1. As shown in Fig.6-49, place an M6 plain washier on the Frame of Arm Joint Section, then fix the top plate①.
2. Turn ON the power supply, and adjust the position of the switch mounting base② so that the following adjustment conditions can be satisfied. (Fig. 6-50)
3. After completing the adjustment of the switch mounting base and the operation check, detach the top plate and the M6 plain washer.

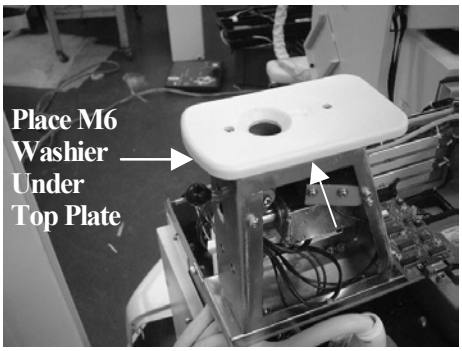


Fig. 6-49

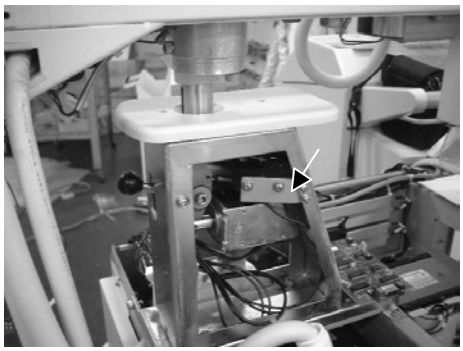


Fig. 6-50

Adjustment Conditions of Micro switch

(a) If the arm is retracted on the condition that the X-ray tube has been pressed in toward the support (adequate retraction status), the indicator on the Control Panel located at the upper part of the main unit should go off. (The OFF status of the indicator should be retained even if the arm is swung in all four directions.)

(b) If the arm is retracted on the condition that the X-ray tube has been pulled out by about 5cm from the status described in the above (a) (inadequate retraction status), the indicator on the Control Panel should be kept turned on.

Operation Check

1. Check that, the panel indication goes off under the retracted status while it remains turned on under the inadequate retraction status.
2. Allow the traveling under the normal arm retraction status, and check that no problem will occur while the unit is traveling.

6-14 Replacement of DC Motor for traveling

<Items Required>

511-77033	DC motor for speed reduction	2 pieces
503-49031-09	Label	1 piece
072-60321-02	Wiring band CV-100	10 pieces

<Tools Required>

Phillips screwdriver

L-head wrench for M10 hexagon socket head cap screws

Wood block (40mm × 90mm × length 600mm) 4 pieces

Nipper

LOCKTITE to prevent loosening of bolts

<Procedures>

1. Turn ON the key switch, and lift the arm down to the position shown in Fig. 6-51.

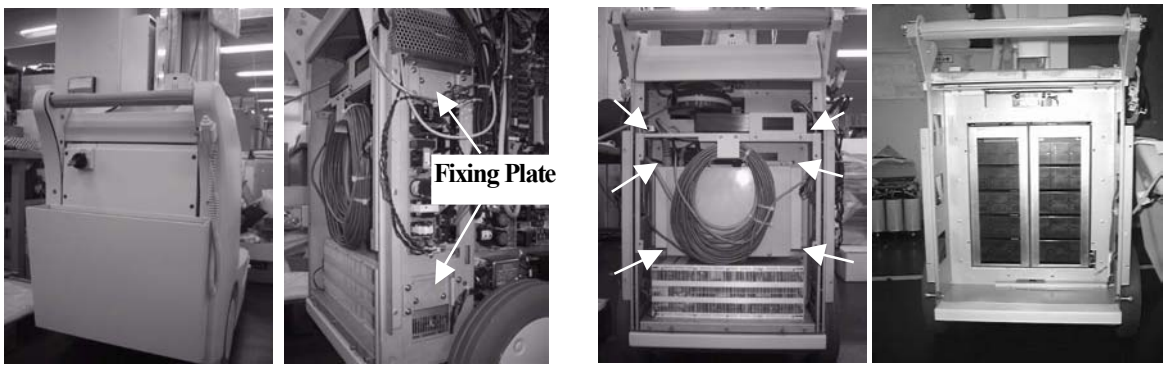
Fig. 6-51 Arm position to replace the battery

WARNING

Be sure to start replacing the battery after moving the arm down to the position shown in Fig. 6-51. Otherwise the unit may topple over when battery is replaced.

2. Turn OFF the key switch and OFF the main breaker as well.
3. Remove FPD, FPD box and the side covers. (Refer to 6-1-2.)
4. Remove the Fixing Plates which are fixing DR assy to the main frame. (Refer to Fig.6-52(b).)
5. Disconnect the cable on DR assy. However, the cable between FPD and POWER BOX is not disconnected.
6. Remove the six screws as shown in Fig.6-52(C) ,pull out the DR assy.

Rear view of the unit



(a) (b) (c)

Fig. 6-52 How to remove FPD box and DR assy

7. As shown in Fig. 6-53, detach the cable cover for DC motors.

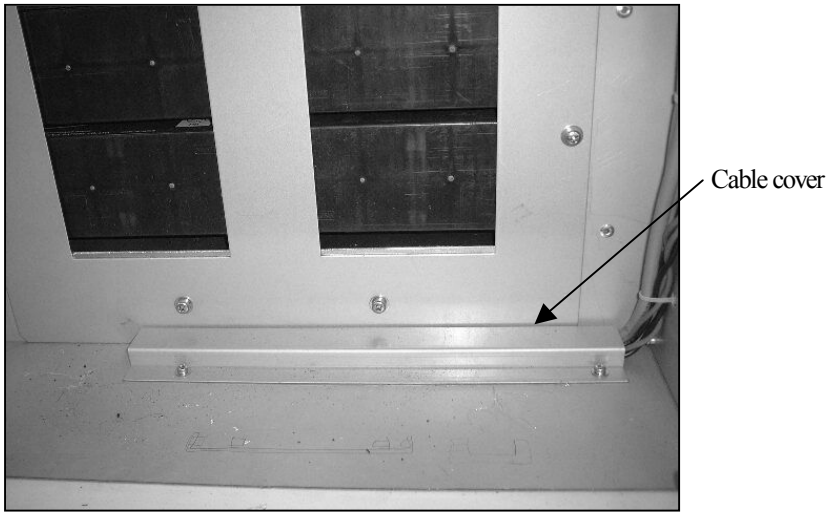


Fig. 6-53 Remove Cable Covers for DC motors

8. Put a label on respective connectors of two new DC motors. (Refer to the wiring diagram shown in Fig. 6-54 (c).)

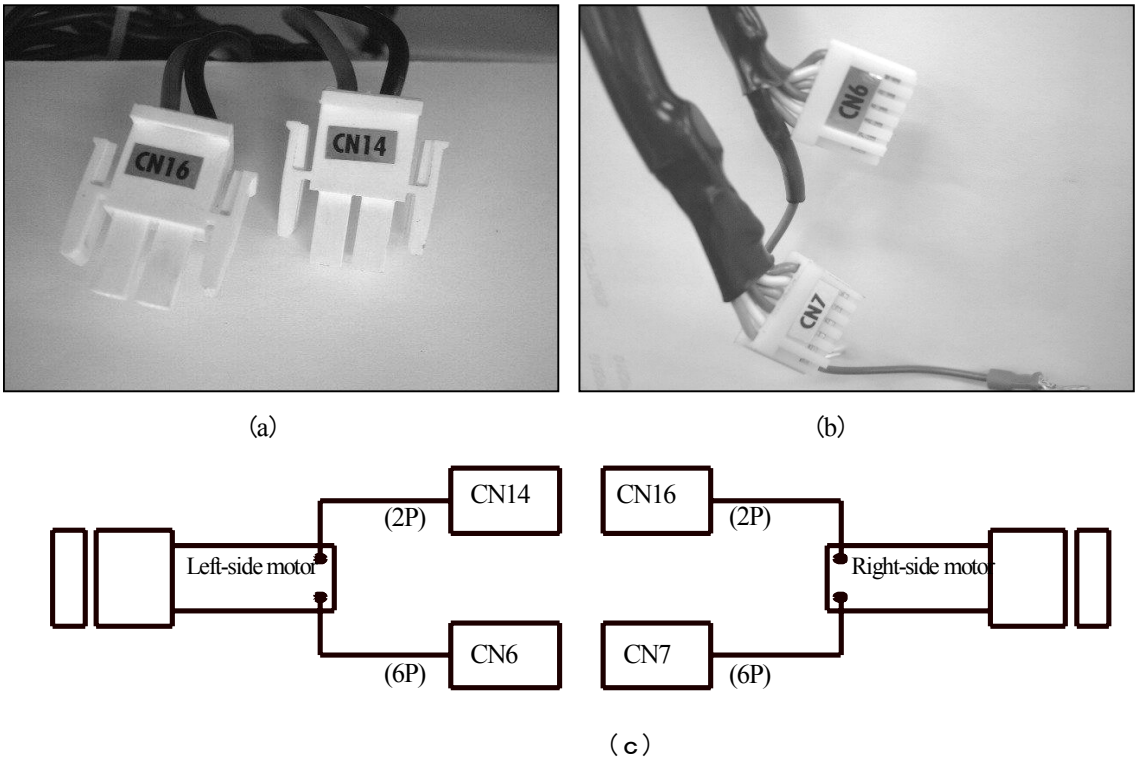


Fig. 6-54 Label on Connectors of DC motor

9. As shown in Fig. 6-55, detach the wheel cover.

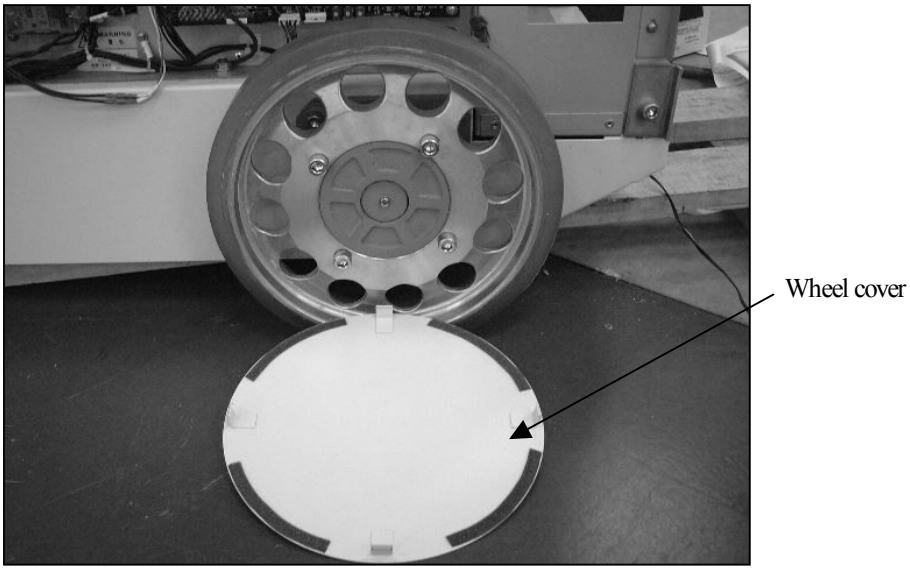


Fig. 6-55 Remove the Wheel Cover

10. As shown in Fig. 6-56, loosen the hexagon socket head cap screws that fix the wheel.

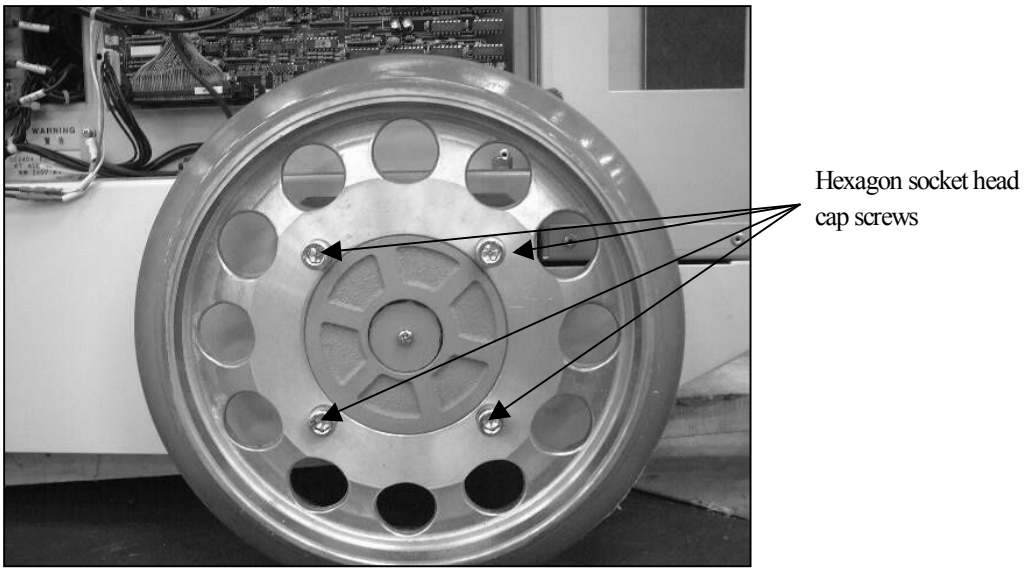


Fig. 6-56 Loosen the Fixing Bolts of the Wheel

11. As shown in Fig. 6-57, lift the main body by using wood blocks, remove the bolts that have been loosened in above step 10, and detach the wheel.

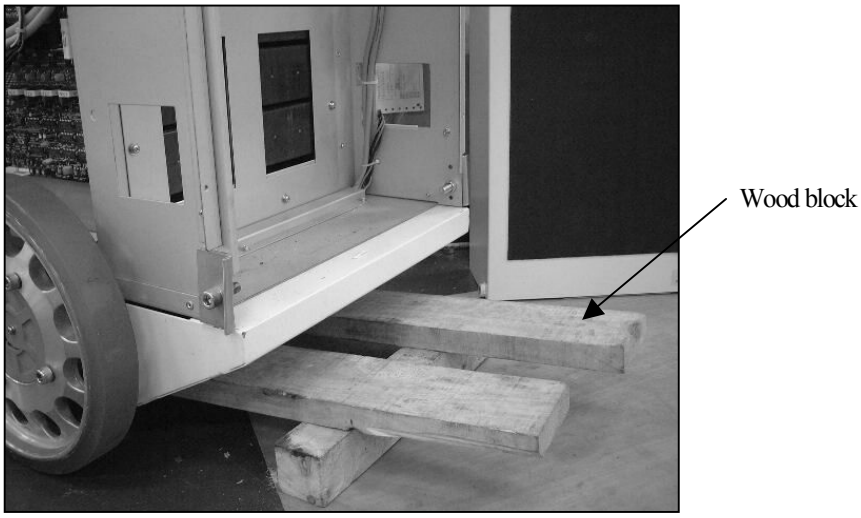


Fig. 6-57

12. As shown in Fig. 6-58, detach the hexagon socket head bolts which fix the motor to the main frame.

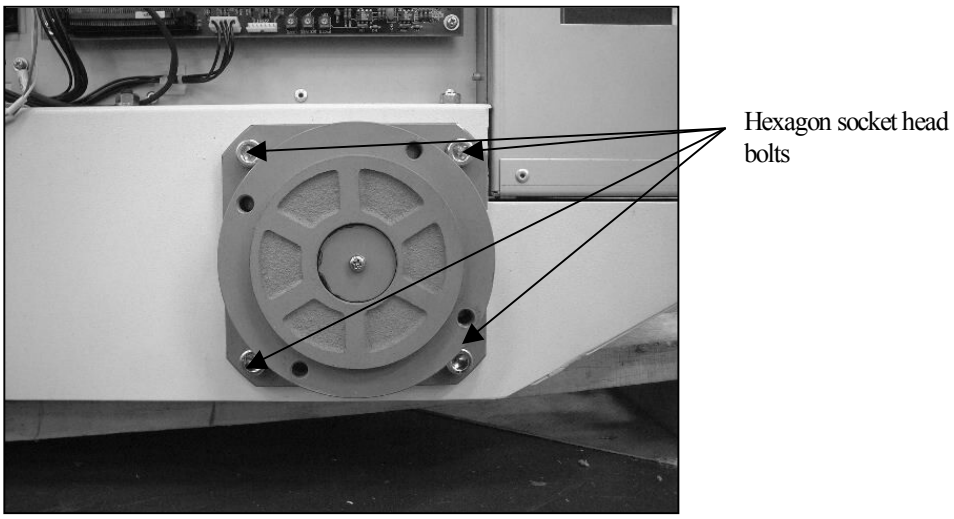
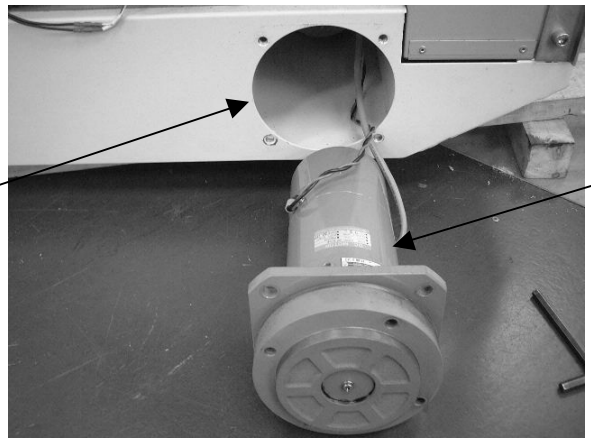


Fig. 6-58

13. As shown in Fig. 6-59, disconnect the ground wire, cut the wiring band, and take out the motor.

* The encircled area shows the point where the wiring band is to be cut.

Ground wire



Motor

Motor mounting hole

Fig. 6-59

14. Pass the cable through the motor mounting hole, apply wiring as shown in Fig. 6-60, and connect the wires to the MU DRIVER-2 PCB.

<Notes> 1. Check that the ground wire and the connectors have been securely connected.
2. Before mounting the motor, turn on the power supply (also the main breaker) to check the motor operation by slightly rotating the handle. (See the following descriptions.)

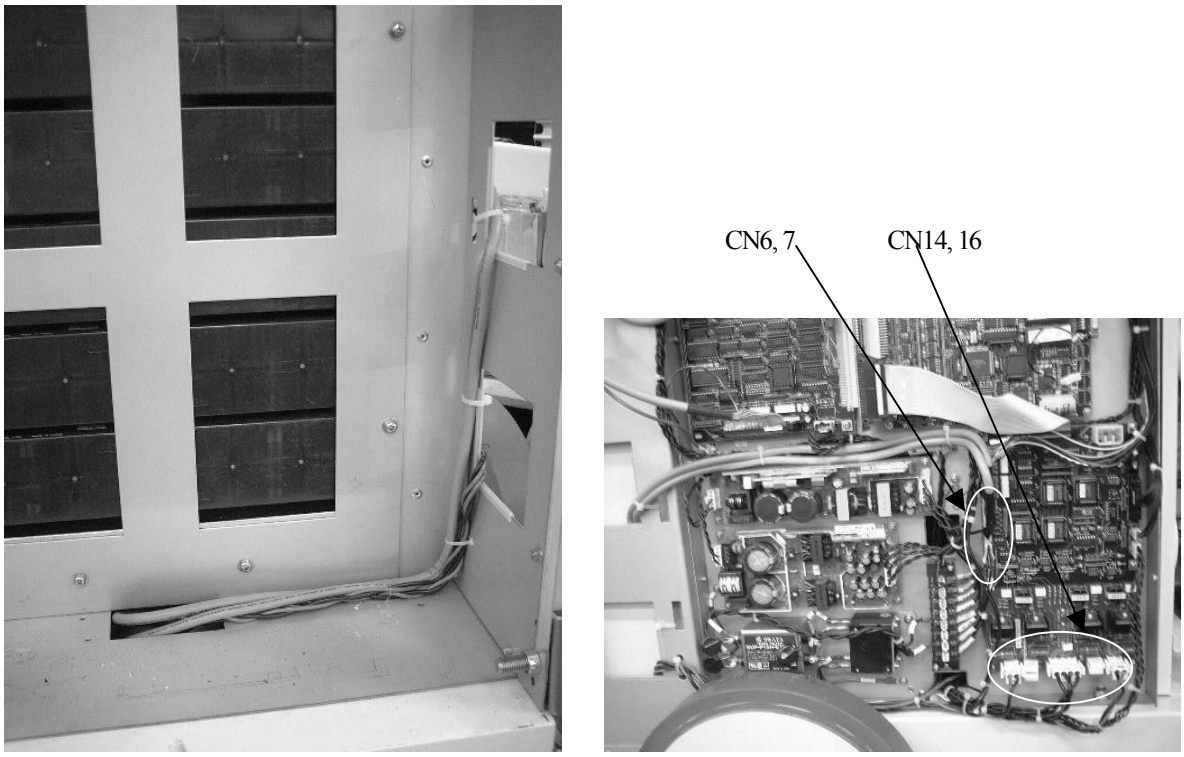


Fig. 6-60

15. Mount the motor.

<Notes> 1. Mount the motor so that the cutting lack of a semicircle type of the motor mounting part may turn forward of the device.
2. When you mount the motor, be sure to apply LOCTITE to prevent loosening of bolts.
3. Be careful not to allow cables to be caught in between edges of the right and the left motor.

16. Mount the wheels and the wheel covers, and detach the wood blocks.

17. Fix the cables with the cable cover, and mount the cassette BOX.

18. Mount the side covers.

19. Check the motor operation again.

<How to check the Motor Operation>
Turn on the power supply, and check the following points:
1. The rotation speeds of the right and the left motors will vary according to the operation force of the handle for traveling.
2. The input from the right and the left handles will coincide with the rotational direction of wheels.
3. The brake will be properly activated.

If you find any unusual situation in the operation, be sure to check if the connector has been plugged in correctly.

6-15 Replacement of PC for CXDI-50G

Replace the PC by using the following procedure.

1. Turn OFF the key switch and OFF the main breaker as well.
2. Remove FPD, FPD box and the right side cover. (Refer to 6-1-2.)
3. Disconnect the cables which are connected to the PC.
4. Remove the fixing plate for the PC. (This fixing plate is just pressing and fix the PC with the rubber sheet on it.)
5. Remove and replace the PC to the new one.
6. Connect the cables to the PC, then turn ON the key switch and turn ON DR system.
7. Press Line ON switch on the left side of PC, then confirm that PC turns ON. (You need to press this Line ON switch once after replacement of PC. Otherwise, the PC will never be able to turn ON.)
8. Perform each setting for CXDI-50G as below referring to "4-2-9 Installing CXDI-50G" and "CXDI-50G Service Manual" .

   (1)Network Settings
   (2)Linearity check of Transfer Image Density.
   (3)Operation Unit Gamma correction.
   (4)FD Backup of data that sets backup when it is set.
   (5)Calibration
   (6)Self Test

9. Attach FPD, FPD box and the right side cover again.

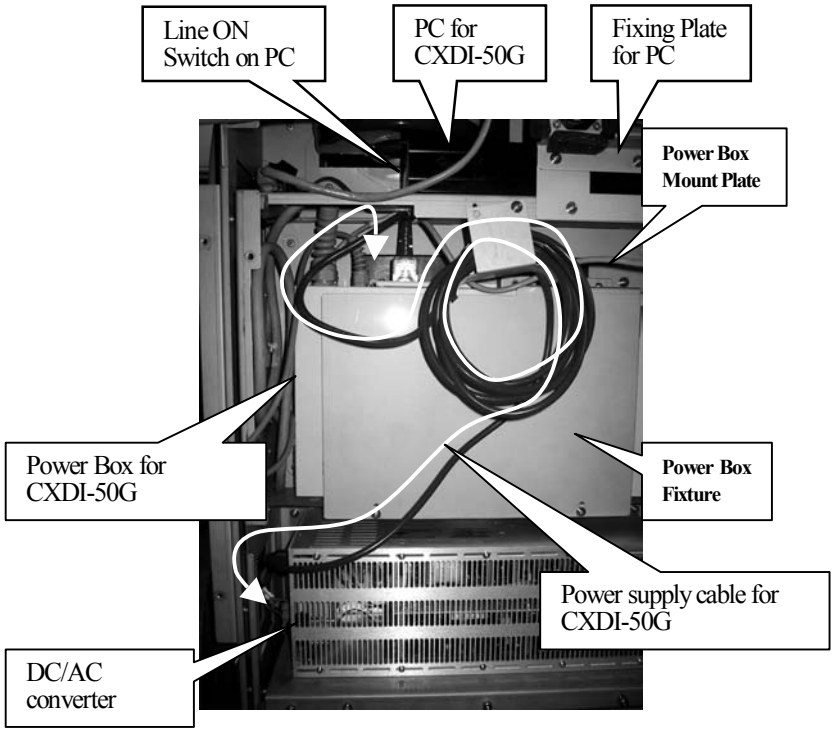


Fig. 6-61 How to replace the PC

7-1 Self-diagnosis Function

7.1.1 Alarm message list

Display	Description
H1	With the set exposure condition, the heat accumulated on the anode of the X-ray tube is over tolerance. Reduce the exposure condition, or stop exposure until warning code disappeared.
H2	The heat accumulated on the anode of the X-ray tube has reached to its tolerance limit. Stop exposures until this warning code disappeared.
H4	The temperature of X-ray tube assembly is too high. Stop exposures until this warning code disappeared.
E	The battery for CPU memory backup needs to be replaced now. Contact your nearest authorized Shimadzu service center.
EEE	The life of battery for CPU memory backup has expired. Contact your nearest authorized Shimadzu service center.

Table 7-1 Alarm Message List

NOTE) The CPU memory battery (lithium battery) backs up the SRAM on the NEXSC PCB. When the life of this lithium battery has expired, the contents will be displayed just before the power was turned off , the error log and the time setting will be erased. However, the MUX-100D can still be operated, with some inconvenience though.

7.1.2 Error message list

Display	Description
F01,F02	The supply voltage is out of its normal range.
F03	The power supply circuit in the system is at fault.
F11～F14	The X-ray tube voltage control is at fault.
F21～F23	The X-ray tube current control is at fault.
F31～F33	The filament heating control is at fault.
F51～F5F	The charge control is at fault.
F61	The starter is at fault.
F62	There is abnormality in the Bucky unit operation.
F6E、F6F	The irradiation control or photo timer

Table 7-2 Error Message List

Refer to Appendix D of MUX-100D Installation Manual about the detail of Error Message List.

7-2 Countermeasures against Error Messages

Error messages displayed on the panel and the countermeasures are described in details as the following.

7-2.1 H1 and H2

The CPU calculates the accumulated heat capacity based on previous exposure, then issues these alarm messages. If either of these messages is issued even while there is not so many exposure, check the voltage of lithium battery and initialize the CPU.

7-2.2 H3

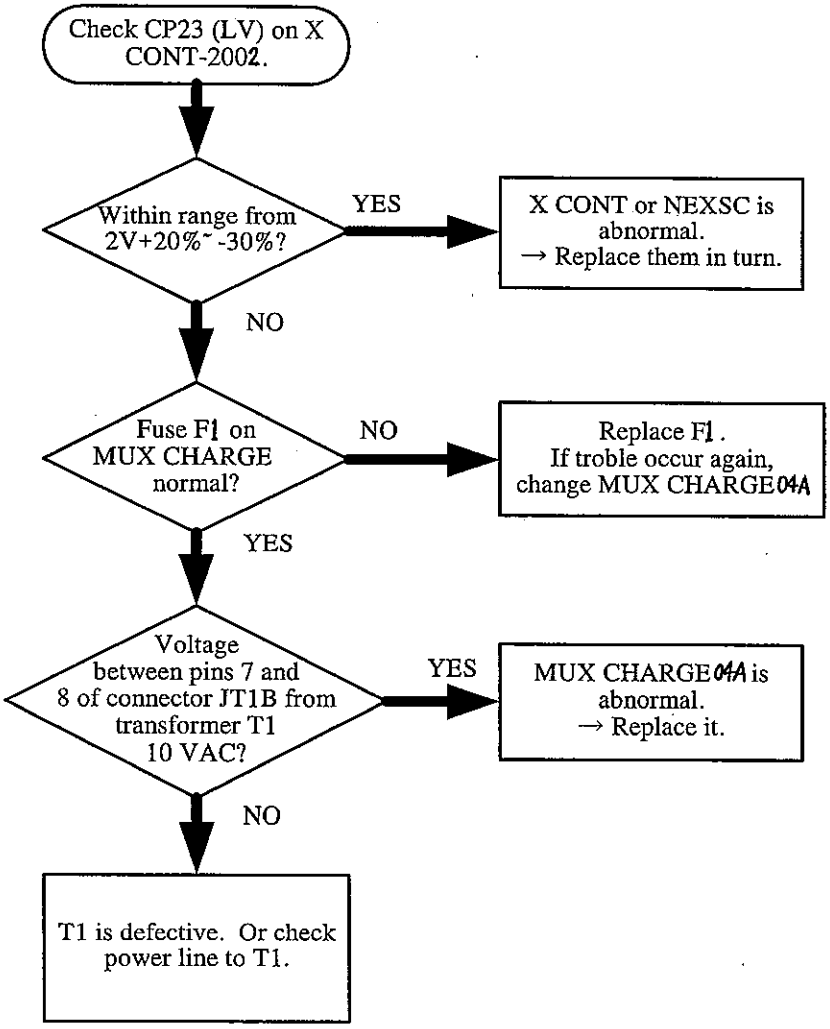
When the thermal switch of the X-ray tube is activated, this message will be displayed. If this message is displayed even while the X-ray tube is not hot at all, check the thermal switch signal.

7-2.3 F01 and F02

(detected by software)

F01: The supply voltage is higher by approximately 20% or more than the normal value.

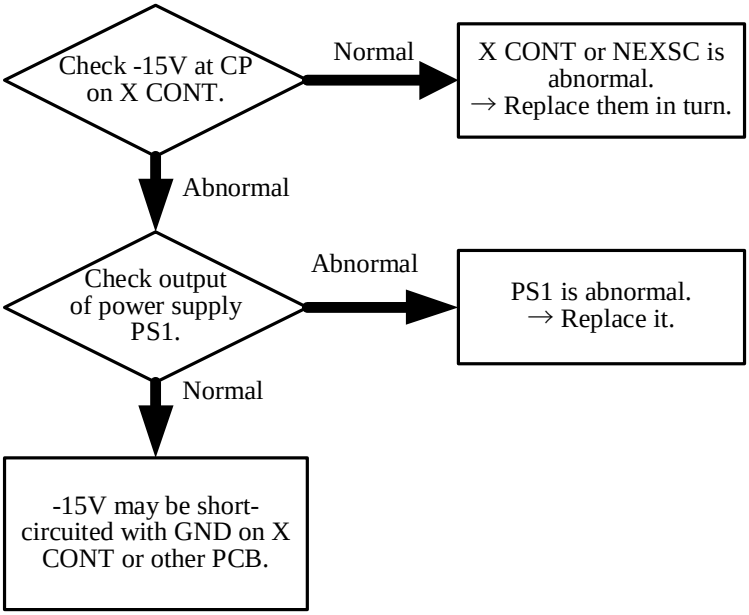
F02: The supply voltage is lower by approximately 30% or more than the normal value.



7-2.4 F03

(detected by hardware)

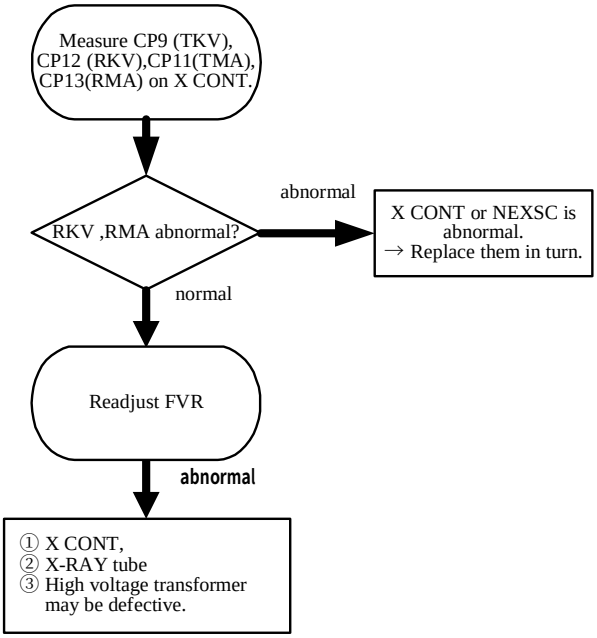
The -15V power supply for the control circuit is abnormal.



7-2.5 F11 (KV OVER)

(detected by software, at 20ms after exposure and each 100ms)

The measured tube voltage is higher by approximately 30 kV or more than the preset value.

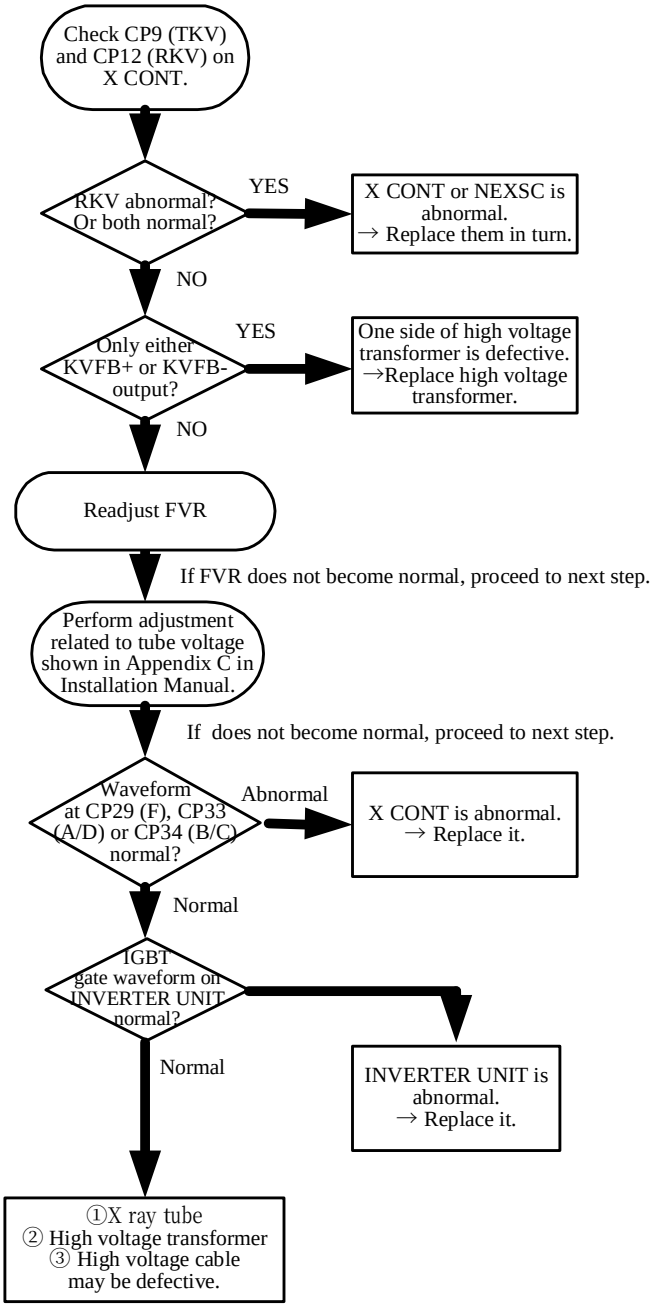


7-2.6 F12 (KV UNDER)

The measured tube voltage is lower by 50% or more than the preset value (detected by software, at 20ms after exposure and at each 100ms)

NOTE) Most probabily that glow discharge has occurred in the X-ray tube.

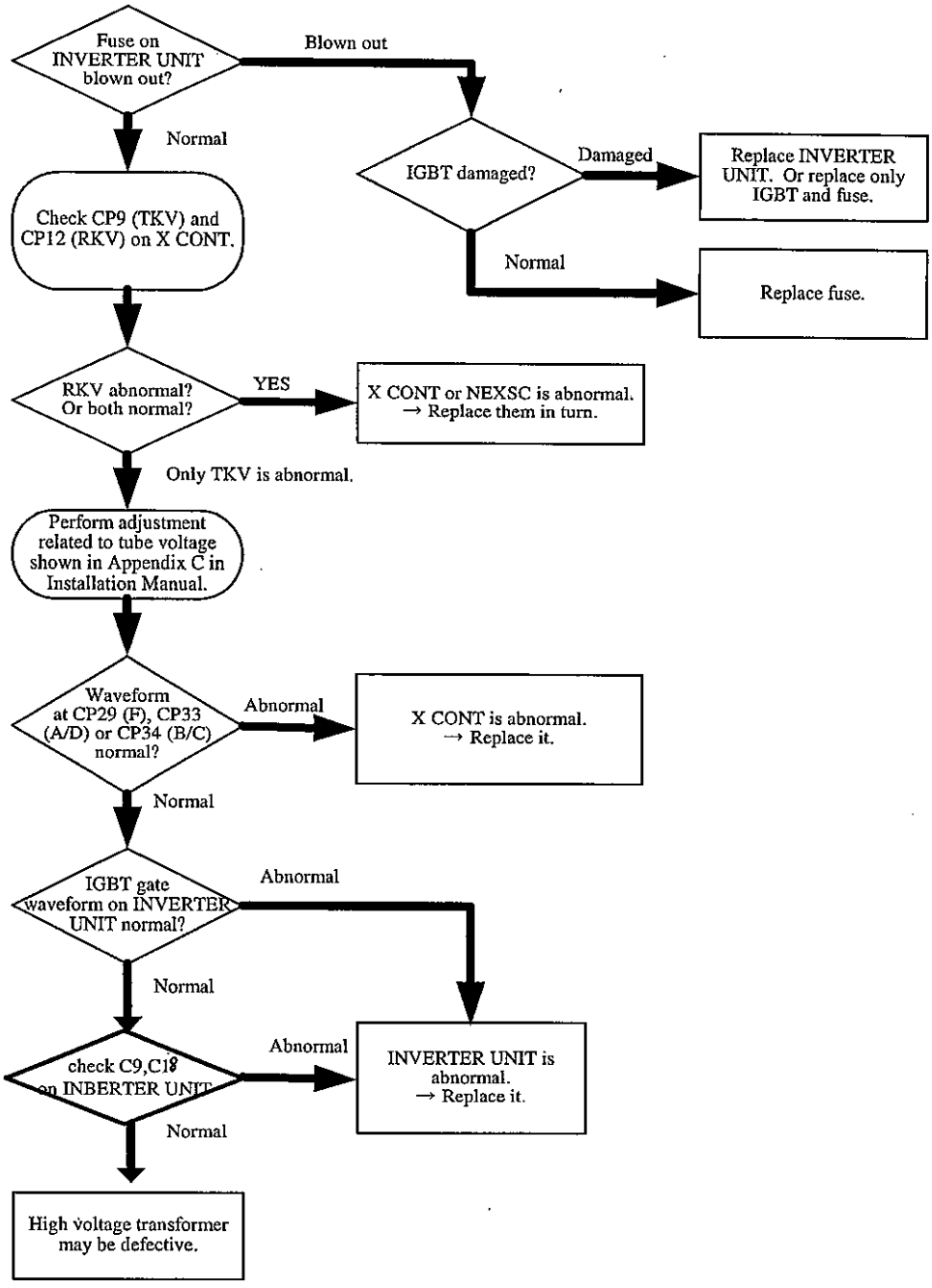
When checking the IGBT gate waveform, take proper action such as short-circuiting to prevent generation of high voltage in accordance with Appendix C in the Installation Manual.



7-2.7 F13 (NO KV)

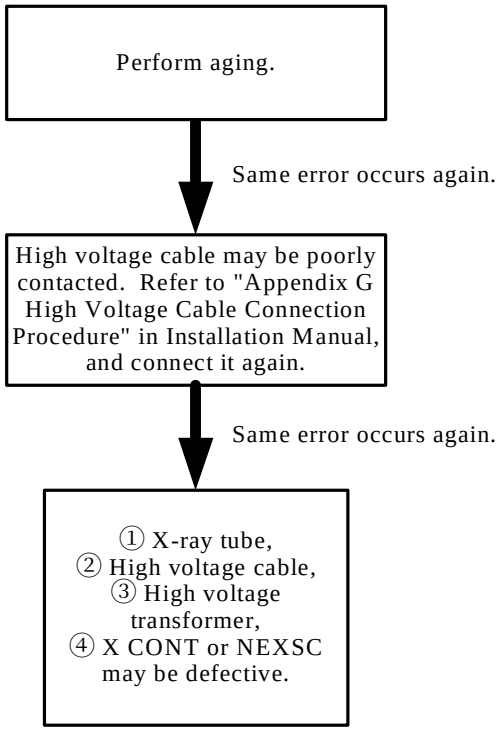
The measured tube voltage is approximately 10 kV or less (detected by software, at 20ms after exposure and at each 100ms)

When checking the IGBT gate waveform, take proper action such as short-circuiting to prevent generation of high voltage in accordance with Appendix C in the Installation Manual.



7-2.8 F14 (KV BRAKE)

Abnormal measured tube voltage or X-ray tube discharge is detected (by the hardware).
This error message actually assume discharge in the high voltage system (especially the X-ray tube). This error may be eliminated by aging. Perform aging first.



Judgement in the last item in the flow chart above is difficult. (Possibility of a defective PCB is low, false error message could be displayed sometimes.)
If either of the following phenomena is detected, it can be clearly determined that discharge has occurred in the high voltage system.

1. Discharge sound "pop" is issued during exposure.
2. The error message is not issued at low kV, but is issued while the kV is rising.
3. The glass is clearly clouded (due to evaporation of the target material) when seen from the X-ray tube irradiation port.
4. The target is clearly rough when seen from the X-ray tube irradiation port.
5. Spark discharge like thick thunderbolt can be seen at the time of exposure from the X-ray tube irradiation port.
   (Make sure to take protective measures against radiation such as use of lead glass.)

   An aluminum filter is provided in the X-ray tube irradiation port. When checking the inside of the glass tube, remove the lead cone first, then remove the aluminum filter also.

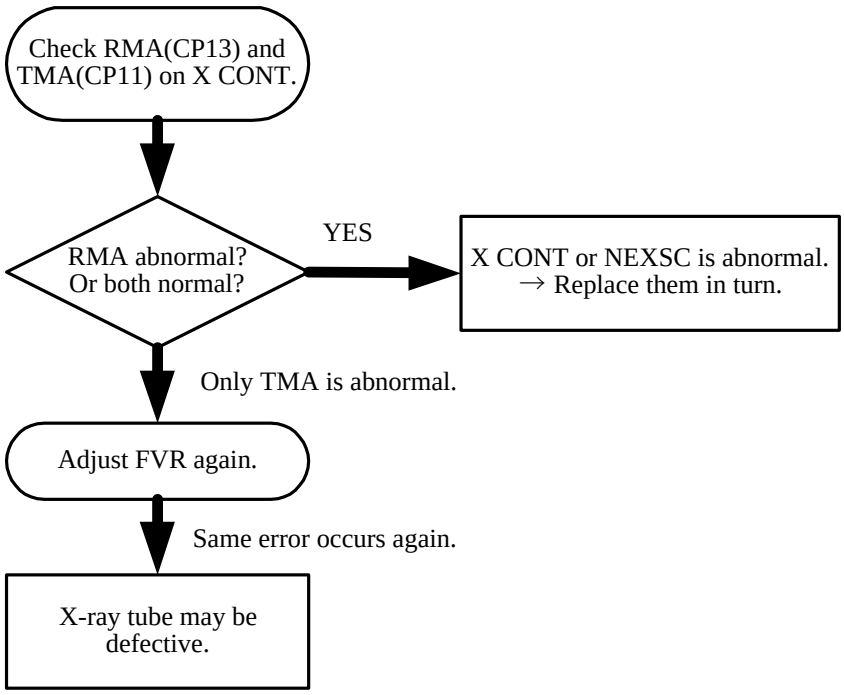
7-2.9 F21 (MA OVER) and F22 (MA UNDER)

(detected by software, at 20ms after exposure and at each 100ms)

F21: The measured tube current is higher by approximately 50 mA or more than the preset value

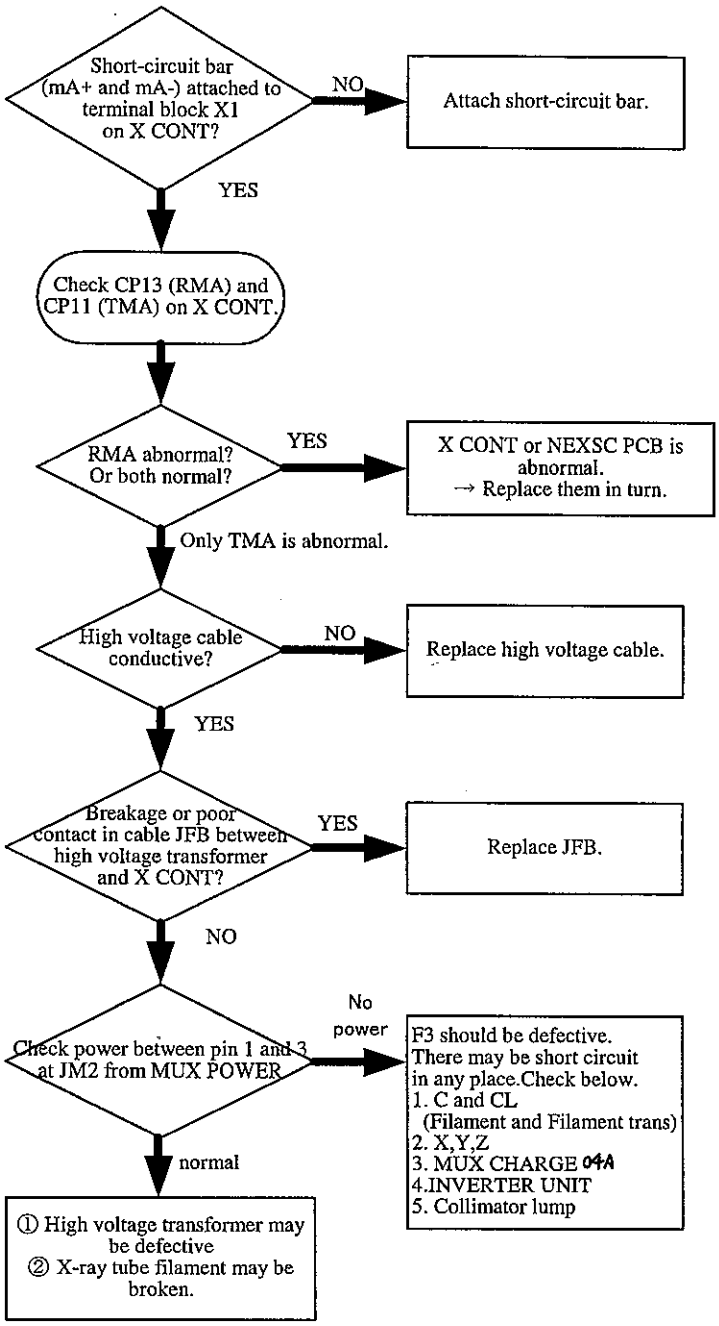
F22: The measured tube current is approximately 50% or less of the preset value .

When these messages are displayed, check the heating system also in accordance with the flow chart for F31 and F32.



7-2.10 F23 (NO MA)

The measured tube current is approximately 10 mA or less (detected by software, at 20ms after exposure and at each 100ms)

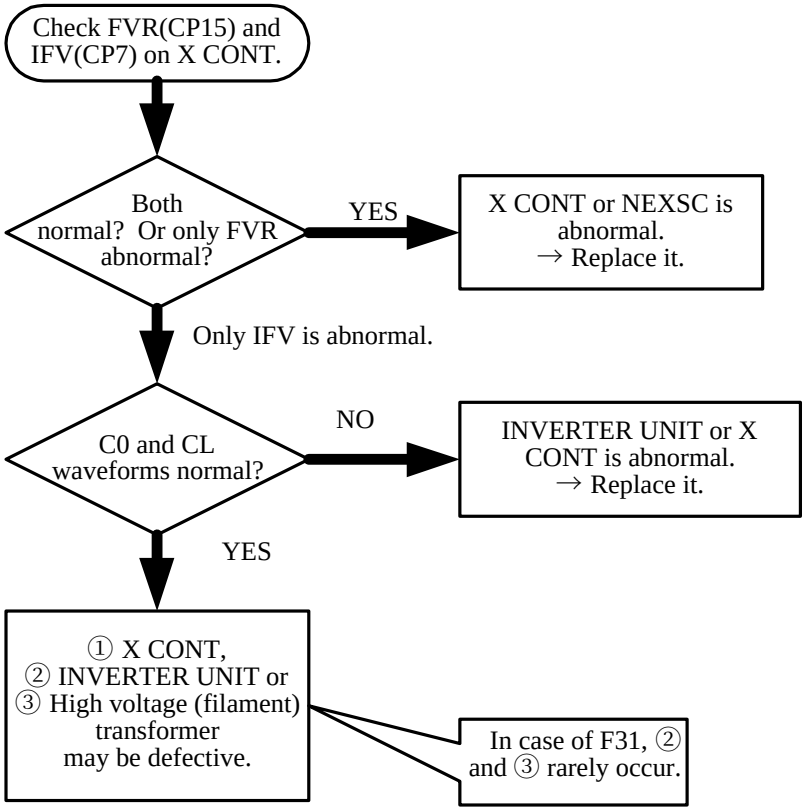


X-ray tube filament check method

Remove the collimator. Look into the X-ray tube from the X-ray tube irradiation port, and check whether the filament is lit in the ready status. Make sure to use lead glass, etc. for protection against radiation.

7-2.11 F31 (IF OVER) and F32 (IF UNDER)

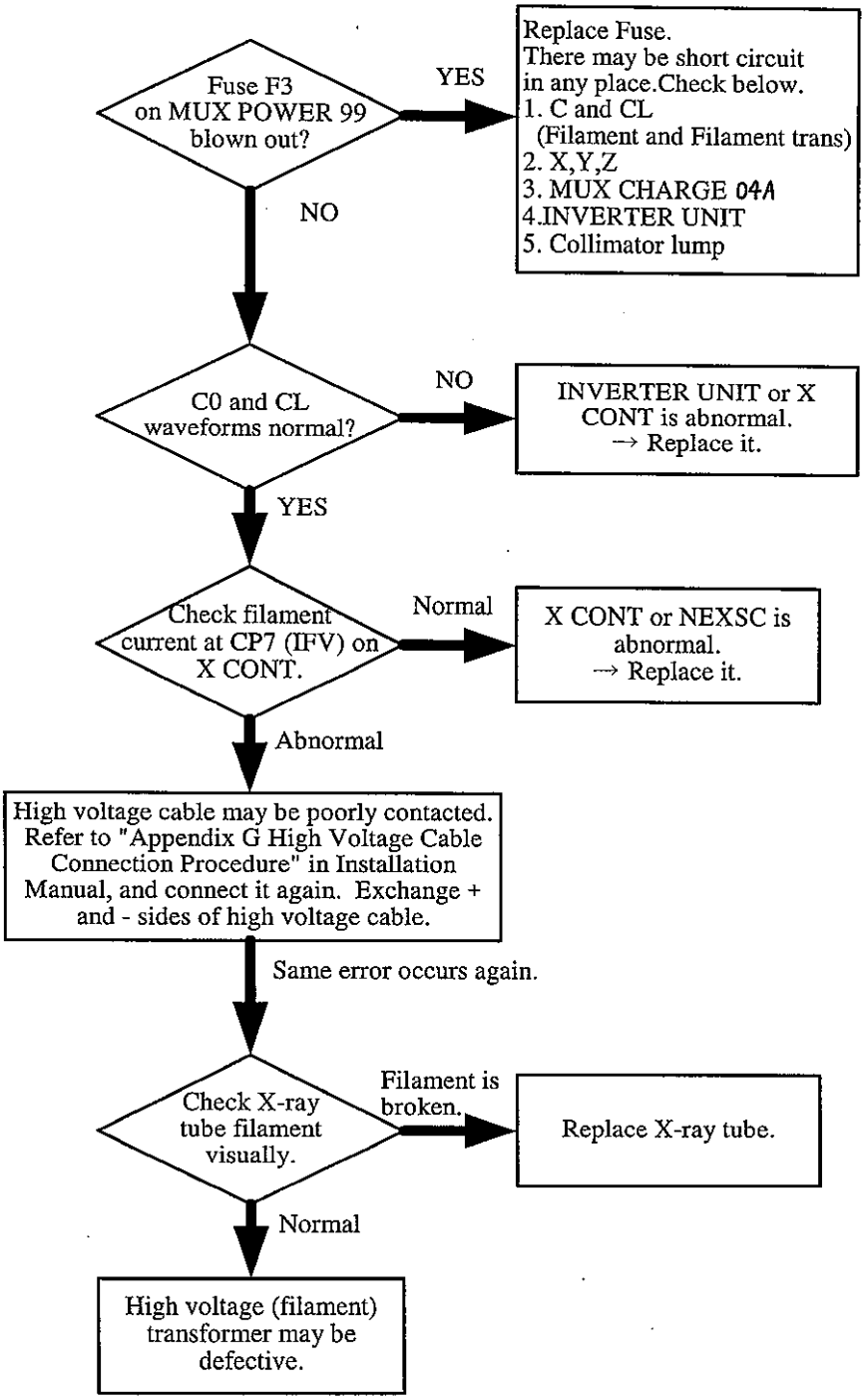
(Detected by the software at each 800ms when prep. and at each 400ms when ready up)
F31: The measured filament current is higher by 50% or more than the preset value .
F32: The measured filament current is lower by 50% or more than the preset value .



In the last item, ① and ② means defect in the detection system. Actually, the possibility of ③ is high.

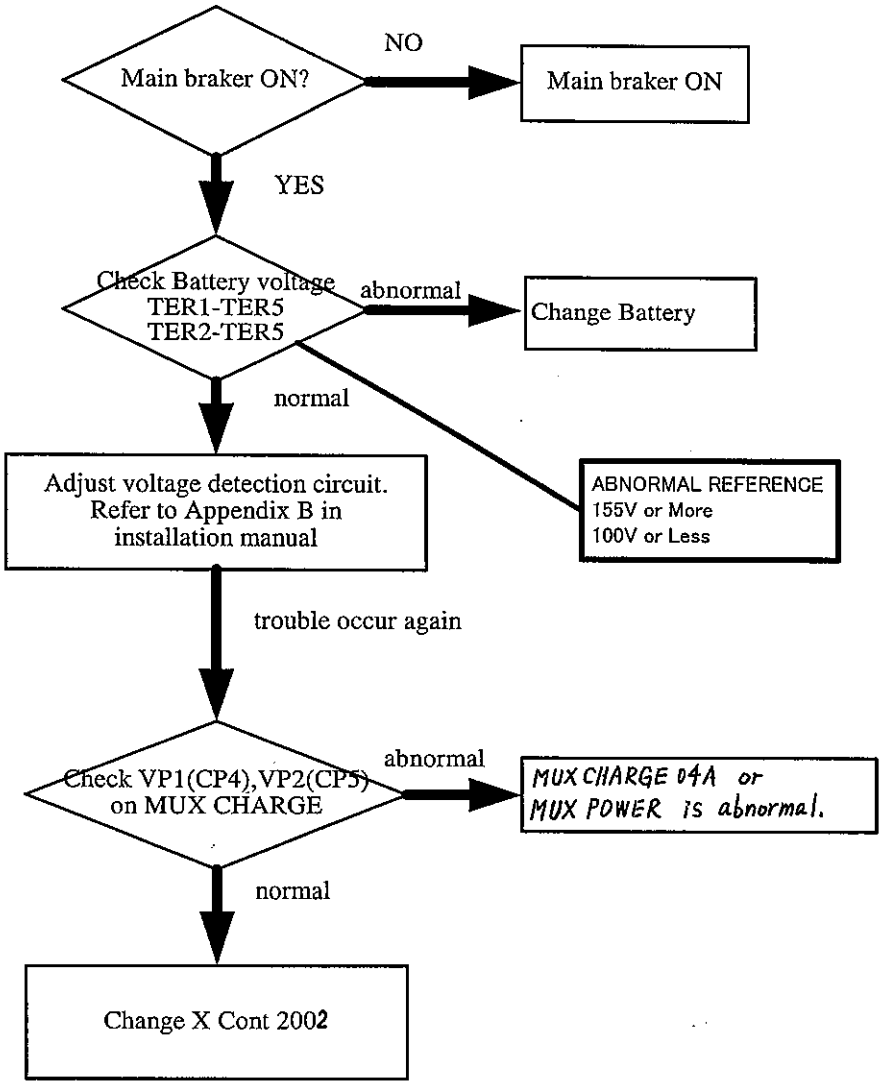
7-2.12 F33 (NO IF)

The measured filament current is approximately 1 A or less .
(Detected by the software at each 800ms when prep. and at each 400ms when ready up)



7-2.13 F51, F52, F54, F55, F56, F5b

F51 : Battery voltage during charging is higher than 155V
F52 : Battery voltage during charging is lower than 100V
F53 : Battery voltage during charging is higher than 155V
F54 : Battery voltage during charging is lower than 100V
F55 : Voltage of plus-side battery is more than 15% higher than that of minus-side battery
F56 : Voltage of minus-side battery is more than 15% higher than that of plus-side battery
F5b : Signal BRON is supplied = battery voltage is more than + or – 155V



7-2.14 F5a, F5E, F5F

F5a : Battery current is more than 3.8A
F5E : Measured charging current more than 50% larger than the specified value has continued for 10 s
F5F : Measured charging current less than 30% than the specified value has continued for 10 s

Confirm the function of battery charging referring to Appendix C.6 of Installation Manual.
The waveform of measured charging current can be confirmed at the following check pins.

CP5(IC) on MUX POWER-04B PCB
→CP9(IC1) on MUX POWER-04A PCB
→CP22(IC) on XCONT-2002 PCB (→NEXSC PCB)

If one of them is normal, it means that battery charging itself is performed correctly ,but one part of detection circuit for charging current is not working well.
For example, if the waveform at all of three check pins are normal, detection circuit on XCONT PCB is maybe not working correctly.

If the waveform at CP5(IC) on MUX POWER-04B PCB is abnormal, check the following before the error happens.

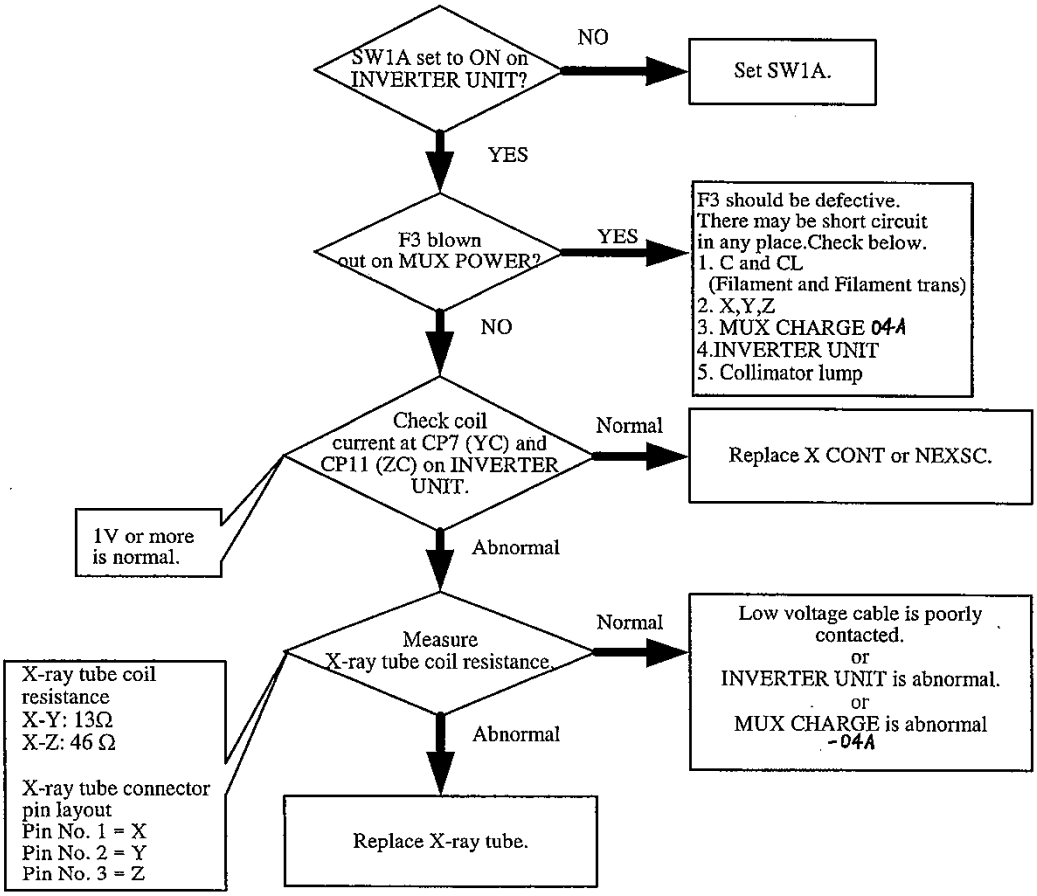
1. Input power supply AC125V to MUX CHARGE-04B from T1 transformer including the fuse F13
2. Fuse F1 on MUX POWER-04B PCB
3. Gate waveform for inverter at CP3(Q14C) ,CP4(Q23C) on MUX POWER-04B PCB
4. Gate waveform for inverter at CP20(Q14C) ,CP22(Q23C) on MUX POWER-04B PCB
5. CHON (Charging ON signal) on MUX POWER-04A PCB (The green LED LD1 should light on.)
6. CP25(PIC) signal :Setting value for charging current from CPU

If you cannot specify the defective part with above checking, replace the following parts as turn.

1. Battery
2. MUX POWER-04A PCB
3. MUX POWER-04B PCB

7-2.15 F61

Starter error (The starter does not issue the current detection confirmation signal.)
The current does not flow in the stator coil, and the rotor does not rotate.



7-2.16 F62

In 1 sec after HX1 is input, XOK is not sent back. This message is not displayed usually.
Confirm the setting of the DIP switch.

7-2.17 F6d

Emergency status.
Check emergency circuit.

7-2.18 F6E

Exposure did not terminate even by the preset timing or mAs setting.
The X CONT-2002 PCB (X-ray cutoff circuit) may be abnormal.

7-2.19 F6F

The exposure control circuit is abnormal.
In 250 msec after the EXR is sent out, the KVT (kV rising signal) is not sent back.
X CONT-2002 PCB may be defective.

7-2.20 D1

Over current is detected. Motor current is detected as more than 6A for more 10sec .
One of the left and right DC Motors is defective.
Motor current can be checked at CP9 (for Left Motor) and CP10 (for Right Motor) on MU DRIVER-2 PCB.
The OFFSET voltage at both check pins is 2.5V when DC Motor is not driven.
The relation is 0.1V/0.67A. So, the error D1 normally happens when the voltage at the above check pins exceeds about 3.5V.
By checking the voltage at both check pins, judge which DC Motor is defective.
If the voltage at both check pins are normal, MU DRIVER-2 PCB or XCONT 2002 PCB may be defective. However, there is still possibility that one of DC Motors is defective.

7-2.21 D3

Abnormal encoder of DC Motor is detected.
The function of the encoders of left and right DC Motors can be checked according to Appendix B.11 of Installation Manual.
By using this checking mode, judge which DC Motor is defective.
If cable connection between the encoders and MU DRIVER-2 PCB is no problem, replace the defective DC Motor.
If both of DC Motors are no problem, MU DRIVER-2 PCB may be defective.

7-2.22 D4~D11

Any switch is ON at POWER ON
Check each switches and bad connection.
If switches and connection are normal, change MUX DRIVE.

D4: Brake release switch
D5: Small movement switch (forward)
D6: Small movement switch (backward)
D7: Drive handle (left)
D8: Drive handle (right)
D9: Bumper switch
D10: Arm lock release switch
D11: Arm lock release lever