

MINXRAY^{INC.®}

HF100AP

SERVICE MANUAL

Ver. 1.4 (August 2012)

This service manual is published for the purpose of for repair and adjustment.
It prohibits the other company from transferring and/or perusing without consent of MIKASA
GLOBE Co., Ltd.

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1.0 INTRODUCTION

This service manual is for the Mikasa's portable x-ray unit.

If you have any questions or need further assistance, please contact us. We are available Monday - Friday, 10:00 - 18:00 Tokyo Time.

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Always connect the power cord to a grounded AC mains electrical outlet.
High voltage is present in some internal components.
X-radiation is emitted during some calibration tests described within this manual.
Observe radiation safety precautions when conducting these tests.

CARELESS OR IMPROPER USE OF X-RAY EQUIPMENT CAN BE EXTREMELY HAZARDOUS.

It is imperative that this equipment be operated and serviced only by trained personnel familiar with the safety precautions required to prevent excessive exposure to primary and secondary radiation, the dangers of exposure to x-radiation, and the proper use of the equipment and instrumentation discussed in this manual. All personnel authorized to operate or service this equipment should be fully acquainted with the established maximum permissible doses, safety recommendations and procedures for working with high voltage components, and testing and calibration instrumentation.

Although this x-ray unit incorporates protective design features for limiting both the direct (primary) x-ray beam and the secondary radiation produced by this beam, design factors alone cannot prevent human carelessness, negligence, or lack of knowledge. This apparatus is sold with the understanding that the user assumes sole responsibility for radiation and electrical safety, and we do not accept any responsibility for:

1. Injury or danger to patient or other personnel from x-ray exposure or electrical shock.
2. Overexposure due to poor operating techniques or procedures.
3. Equipment not properly serviced, installed, or maintained in accordance with operation and service manuals.
4. Equipment which has been modified or tampered with in any way.

2.0 DEVICE HISTORY

Item No.	Date	Contents	Start Serial No.
1	May 29, 2004	1st-production(5sets)	27894
2	October 31, 2005	Change CPU M2000 to M2400	29728
3	July 20, 2008	Change collimator mounting ring	33124
4	October 30, 2008	Change M9112 to M9112B	33560
5	March 1, 2009	MAIN program changed Ver1.21 to 1.21b (Modification of the adjustment constant of a timer)	33848
6	July 28, 2009	Modification of the mounting position of the earth wire on the chassis	34288
7	January 30, 2009	Add DR interface connector	33724
8	August 31, 2010	Collimator change R400V type B01 to type B04	35021
9	October 12, 2011	DR interface PC board change M2314	35720

3.0 SPECIFICATIONS

Apparent resistance of supply mains	0.1 ohm
Protection against electrical shock	Type B, Class I
Mode of operation	Continuous operation with intermittent loading
Duty cycle	1 : 60 (1 sec. On, 60 sec. Off)
Degree of protection against the ingress of water	Splash-proof equipment (IEC Publication 529)
Degree of safety of application	Equipment not suitable for use in the presence of a flammable anesthetic mixture with air or with oxygen or nitrous oxide
120V model:	
Power Requirement:	AC, Single phase, 120V, 50/60Hz
Fuse	30A @ 120V
X-ray Generator	
Output range	30 to 60kVDC@ 40mA (0.3 –4.0mAs) 32mA (4.3 –64.8mAs) 62 to 70kVDC@ 35mA (0.3 –3.5mAs) 28mA (3.8 –56.7mAs) 72 to 80kVDC@ 30mA (0.3 –3.0mAs) 24mA (3.2 –48.6mAs) 82 to 100kVDC@ 25mA (0.3 –2.5mAs) 20mA (2.7 –40.5mAs)
230V model:	
Power Requirement:	AC, Single phase, 230V, 50/60Hz
Fuse	15A @ 230V
X-ray Generator	
Output range	30 to 60kVDC@ 40mA (0.3 –80mAs) 62 to 70kVDC@ 35mA (0.3 –70mAs) 72 to 80kVDC@ 30mA (0.3 –60mAs) 82 to 100kVDC@ 25mA (0.3 –50mAs)
Electric power	2.5 kW@ 100kVDC, 25mA
Maximum deviation from fixed factors	Tube potential $\pm 10\%$ Tube current $\pm 20\%$ Exposure time $\pm (10\% + 1 \text{ msec})$
Leakage technique factors	0.35 mA @ 100kV 0.35 mA is a maximum rated continuous Current for 25 mA with duty cycle 1:60
Inherent filtration	2.2 mm Al equivalent

Total filtration	2.9 mm Al equivalent (with collimator)
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X-ray Tube

Manufacturer	TOSHIBA
Type	D-124S
Focal Spot	1.2 mm
Anode heat storage	20 kHU

Collimator (Beam Limiting Device)

Manufacturer	Mikasa X-ray Co., Ltd.
Type	R-400V
Filtration	0.5mmAl

Dimension and weight	290mm (W) x 400mm (L) x 230mm (H) 16.2kgs
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Environmental Conditions For Use

Temperature:	+10°C to +40°C (50°F to 104°F)
Humidity:	30% to 75%, excluding condensation
Atmospheric Pressure:	700hPa to 1060hPa
Other	Avoid using where explosive or corrosive gases are present.

Environmental Conditions For transport and storage

Temperature:	-40°C to +70°C
Humidity:	10% to 100%
Atmospheric Pressure:	500hPa to 1060hPa

Warm up procedure

It is imperative that this equipment should follow this warm up procedure after transport or storage under -30°C. The equipment should be operated only after 12 hours of warm up storage at 10~40°C. No exposure should be made during this warm up period.

Cooling procedure

It is imperative that this equipment should follow this cooling procedure after transport or storage above 70°C. The equipment should be operated only after 12 hours of cooling storage at 10~40°C. No exposure should be made during this cooling period.

Specifications subject to change without notice.

4.0 OPERATING PROCEDURES

CONNECTION: After confirming POWER CORD and EXPOSURE SWITCH are intact, securely connect them to main body of x-ray unit.

(If connector has lock, confirm it is locked.)

Confirm POWER SWITCH is OFF and connect POWER CORD to wall outlet or wall socket of proper mains.

(When you use an extension cord, 3.0 kW should be obtained.)

POWER ON: Set POWER SWITCH on the side of the x-ray unit to ON.

Each indicator will illuminate.

Initial Setting for FFD & FILM system sensitivity:

Initial setting for FFD and Film system sensitivity can be set by dipswitch, which is located in the side of unit.

Before you change and initial setting, turn off the main power switch!

* FFD : This unit has three dip switches, and set a suitable value for FFD each dipswitch as an initial setting.

* Film system sensitivity : This unit has three dip switches, and set a suitable value for Film system each dipswitch as an initial setting.

Operation:

1. Select Initial switches for FFD and Film system sensitivity. (See for example, Fig 1, Fig 2)
2. Turn on the main power switch on the unit.
3. If you need to change the value for FFD, set the value by the ▽ Δ button for FFD.
4. Select the animal type from the buttons of DOG, CAT, BIRD, 1, or 2.
5. In case that you select the buttons of DOG or CAT, you can select the body parts buttons that you will take X-ray film.
6. If you select the buttons of BIRD, 1, or 2, you cannot select the button for the body parts.

7. Select the animal size from the button of S, M, or L.
8. If you select DOG or CAT, measure the thickness and set the value by $\nabla \Delta$ button for THICKNESS.
9. Select the direction from the button of DV or LAT.
10. If you use a grid then press the button for GRID.
11. If you use contrast medium then press the button of CONT.
12. If you check pregnancy, press the button of PG. (This button can be used only when you select the body parts at LOWER ABDOMEN)
13. Illuminate the collimator light and fix the X-ray field.
14. When you press the 1st stage of exposure switch, the green light (READY) on the control panel will be illuminated after about 2 seconds and a buzzer sounds by intermittence.
15. Make sure that the animal is still quiet, and then press the 2nd stage of exposure switch.
16. X-ray is generated at the same time when buzzer sounds continuously and yellow light (X-RAY) is illuminated.



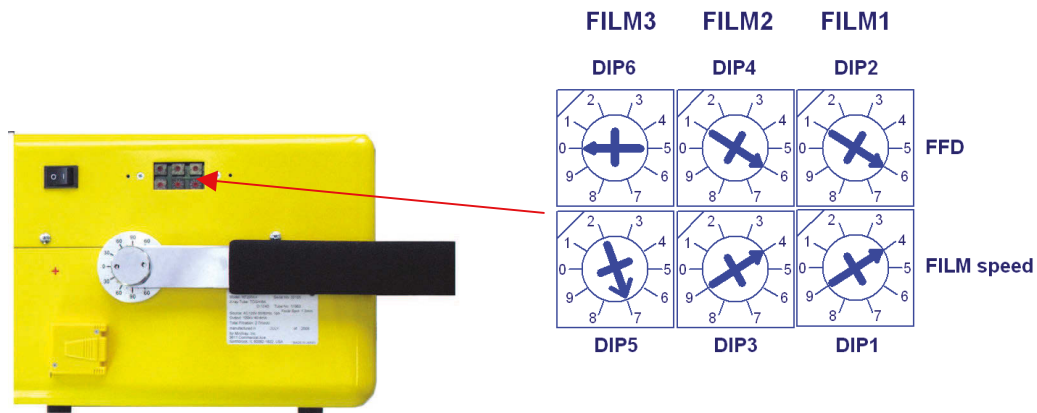
NOTE: The first stage of EXPOSURE SWITCH is pre-heat of filament.

DON'T KEEP ONLY THE FIRST STAGE OF EXPOSURE SWITCH "ON" LONGER THAN 30 SEC.

If the exposure switch is released during exposure, error light will be blinking.

How to set FFD and Film speed:

1. Turn off the main power
2. Push FFD switch at 1 position, turn over position 1 FFD dipswitch at position 6 (1~9)
3. Turn on the main power, then the FFD will be shown as 80cm in LED indication.



Initial Setting for DIP switch

	FILM 1	FILM 2	FILM 3
DIP 1	4		
DIP 2	6		
DIP 3		4	
DIP 4		6	
DIP 5			7
DIP 6			0

FFD: DIP switch 2, 4, 6

Film speed: DIP switch 1, 3, 5

Film speed parameter

DIP switch	FFD	Film speed	
9	95		x2.01
8	90		x1.75
7	85	200	x1.52
6	80		x1.30
5	75		x1.15
4	70	400	x1.00
3	65		x0.85
2	60		x0.72
1	55		x0.61
0	50		x0.52

Adjustment of radiation field

Pressing COLLIMATOR SWITCH or the first stage of EXPOSURE SWITCH will illuminate the x-ray field for approximately 45sec. Adjust radiation field to position of radiograph by two knobs for adjustment of opening.

Manual mAs adjustment

mAs can be adjusted by manual operating. The range is from 0.3mAs to 60mAs.

POWER OFF : When the POWER SWITCH is pressed, all indicators on the control panel are off.



DO NOT SWITCH ON AND OFF QUICKLY IN A SHORT TIME. WHEN TURNING ON AGAIN AFTER TURNING OFF, WAIT FOR AT LEAST 1 MINUTE. OTHERWISE, THE HIGH FREQUENCY INVERTER CANNOT WORK PROPERLY.

ERROR INDICATOR

HF100HA has an ERROR INDICATOR. If the ERROR INDICATOR is on, stop exposing and follow the step below. The unit has malfunctioned and x-ray cannot be generated.

If ERROR INDICATOR is lit even after the EXPOSURE SWITCH is released, it means an unusual situation has occurred. Turn off the MAIN POWER SWITCH, wait 3 minutes, then start procedures over again.

※ If ERROR indicator is lit even when EXPOSURE SWITCH BUTTON is released, it means an unusual situation has occurred. Turn off POWER SWITCH, wait 3 minutes, then start procedures over again

5.0 Main parts

Collimator light switch

Shutter adjust knob

Collimator

DIP switch

Power switch

Angle indicator

Tape measure

Shutter adjust knob

Connector for exposure switch

Connector for DR interface

Connector for power cord

Fuse holder

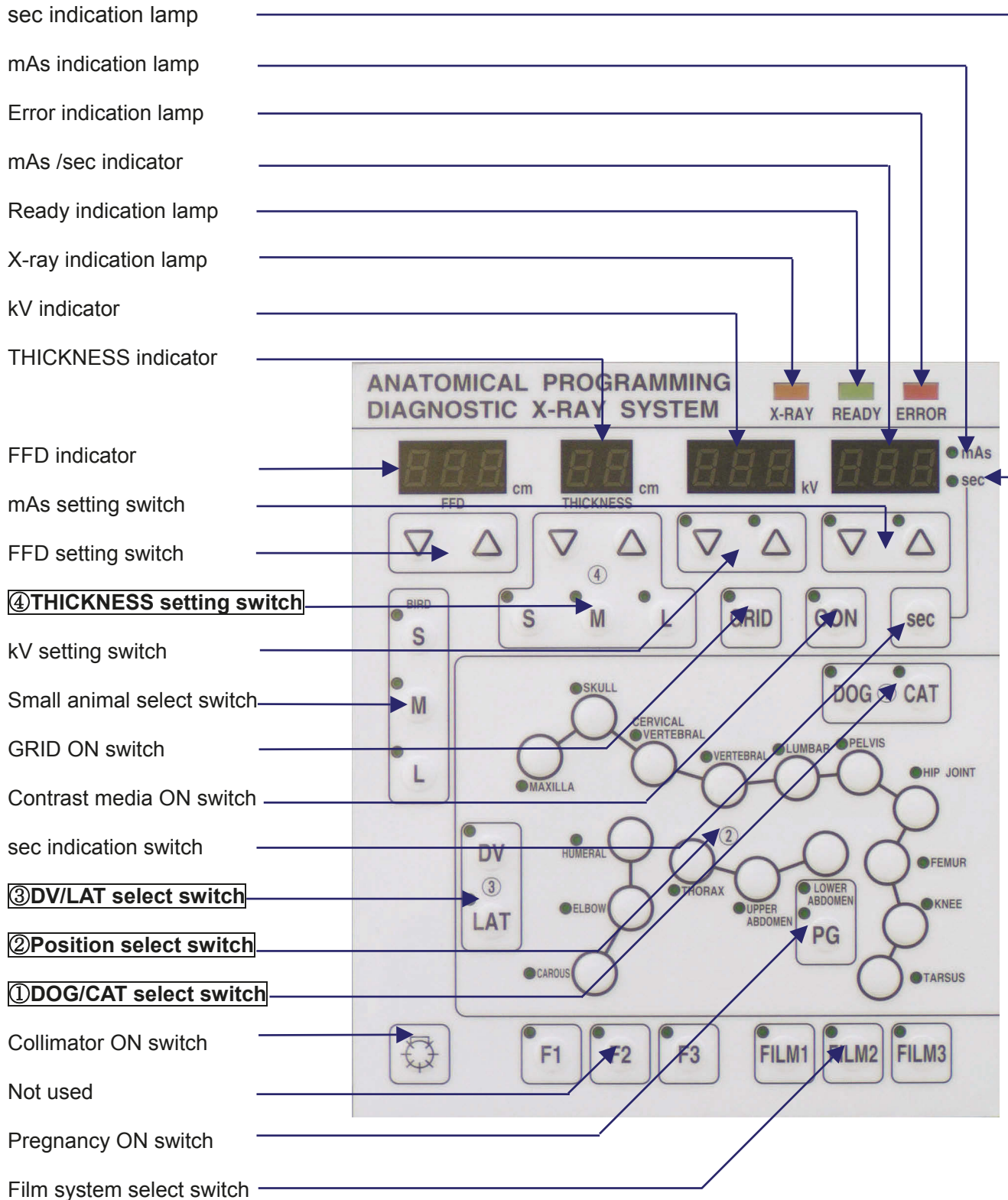


Exposure switch and cord



Power cord

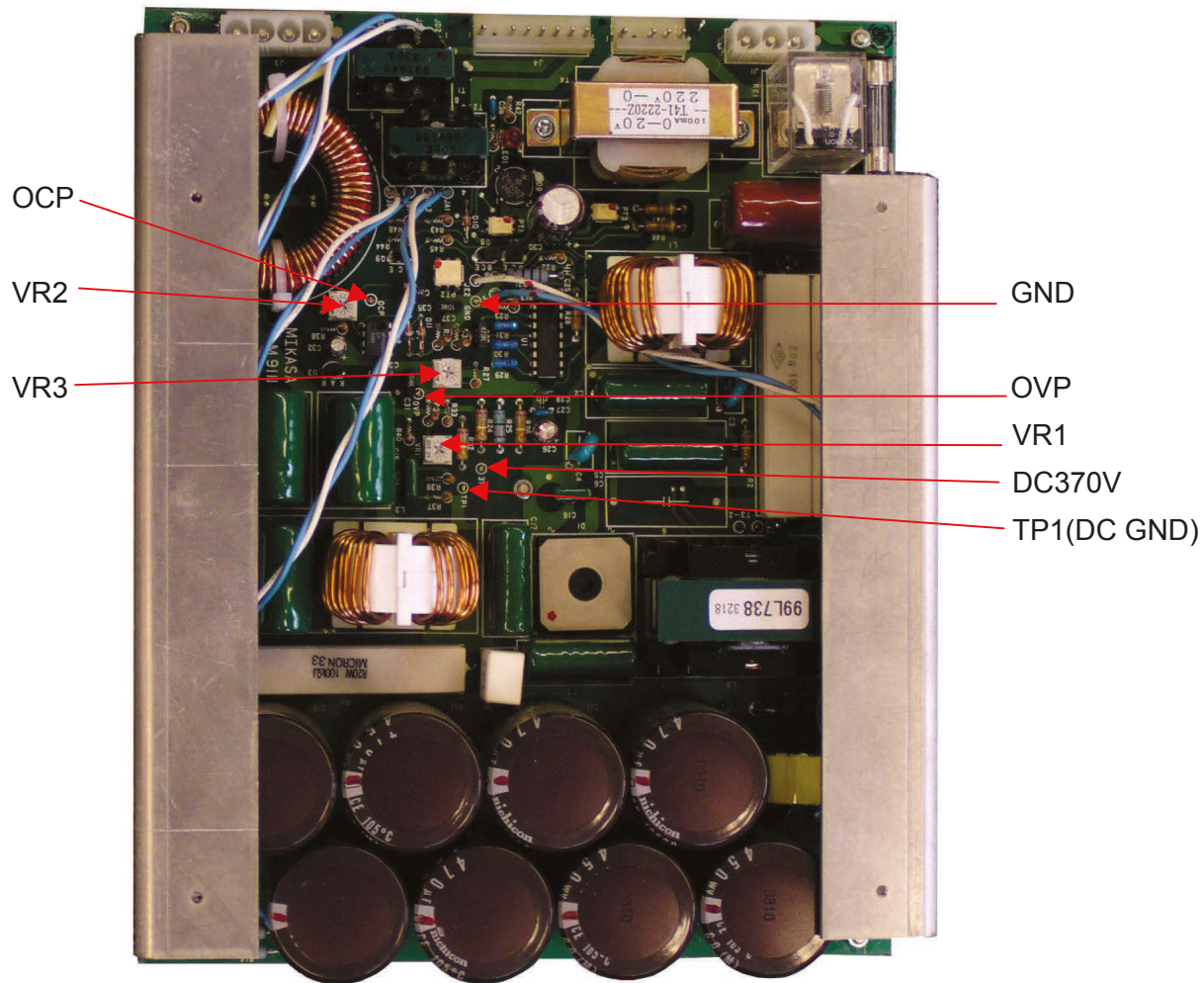
CONTROL PANEL



6.0 Pre-Adjustment

6-1. M9111C PC Board adjustment

※ Each PC Board delivered from the factory has already been adjusted.



**This adjustment has to be done after connecting all connectors completely.
Actual x-ray exposure is not necessary.**

1. Confirmation of DC370V values

Confirm the voltage between TP-DC370V (+) and GND (-) to be greater or equal to DC365V and less than DC400V.

2. Confirmation of OCP values (Over Current Protection circuit)

Confirm the voltage between OCP (+) and GND (-) to be greater or equal to 1.15 V and less than or equal to 1.18 V. The voltage can be adjusted up to 1.30V by turning VR2 if needed.

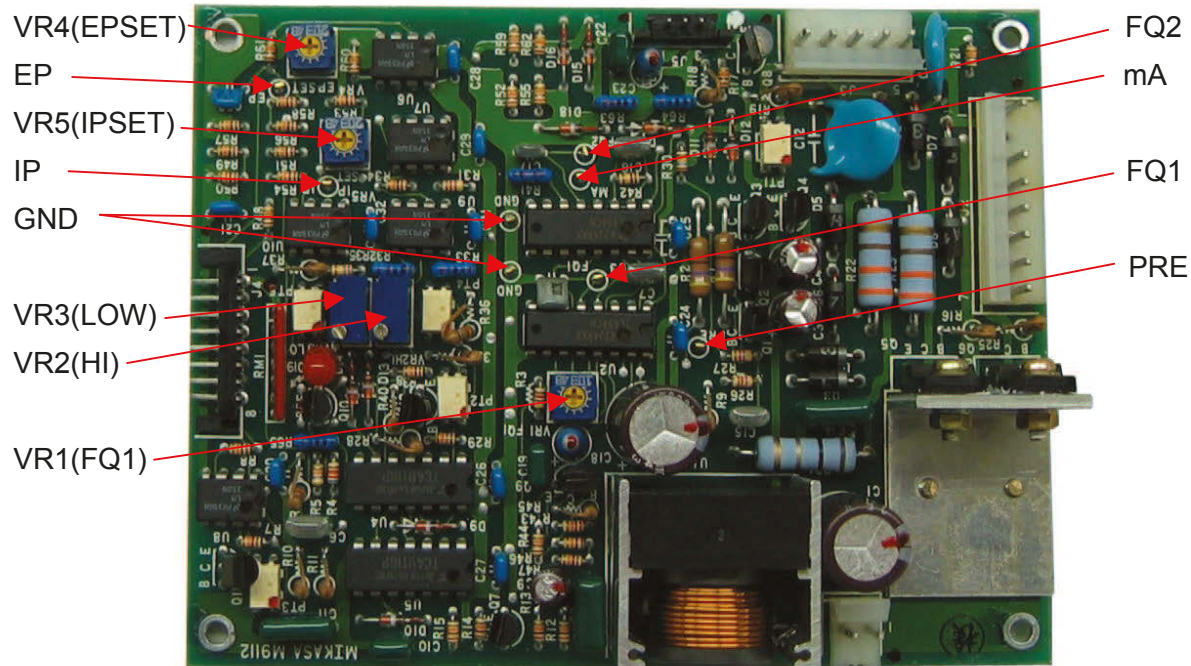
Turning clockwise increases voltage.

3. Confirmation of OVP values. (Over Voltage Protection circuit)

Confirm the voltage between OVP (+) and GND (-) to be greater or equal to 2.22V and less than 2.45V.

6-2. M9112 PC Board adjustment (May, 2004~October, 2008)

※ Each PC Board delivered from the factory has already been adjusted.



**This adjustment has to be done after connecting all connectors completely.
Actual x-ray exposure is not necessary.**

1. Adjustment of FQ1

Adjust frequency between FQ1 (+) and GND (–) to be $125 \text{ kHz} \pm 10\%$ by turning VR1.

Turning clockwise increases frequency.

2. Confirmation of FQ2

Confirm if frequency between FQ2 (+) and GND (–) is $90 \text{ kHz} \pm 10\%$.

3. Set VR4 (EP SET) to the center position.

4. Set VR5 (IP SET) to the center position.

5. Adjustment of VR3 (pre-heat adjustment under 70kV).

Turning clockwise increases voltage.

Adjust voltage between PRE(+) and GND (–) to be 0.53 V by turning VR5

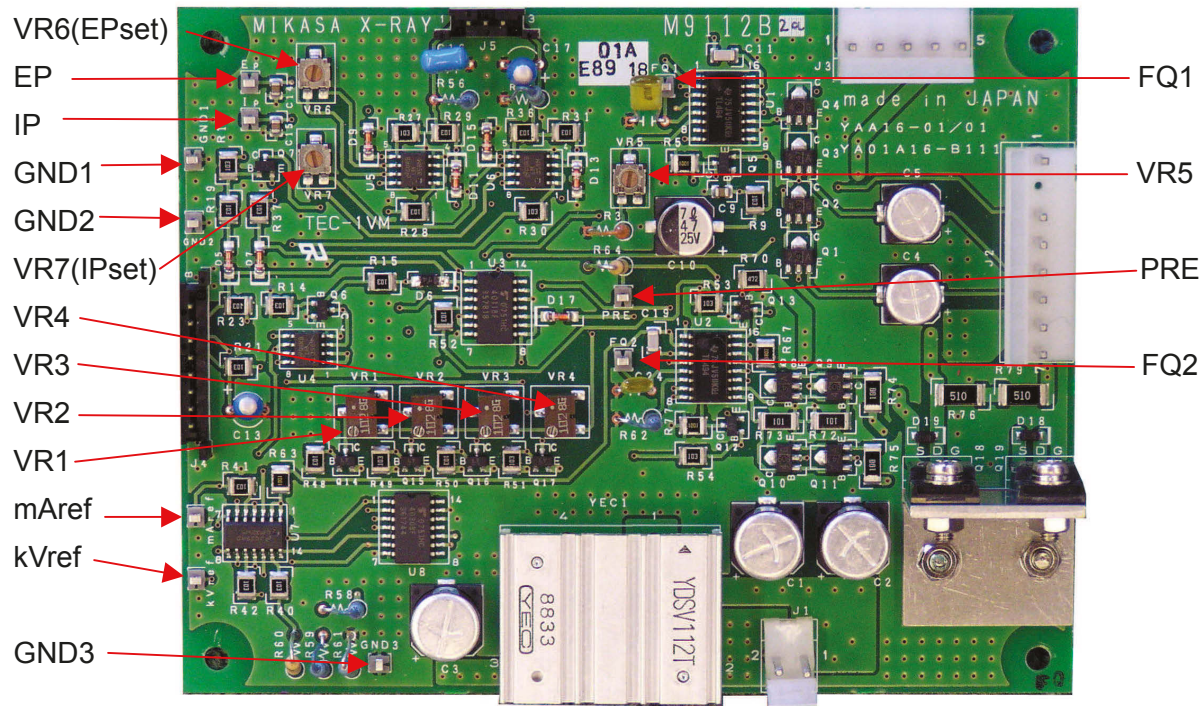
6. Adjustment of VR2(pre-heat adjustment 72 to 100kV) .

Turning clockwise increases voltage.

Adjust voltage between PRE(+) and GND (–) to be 0.50 V by turning VR6

M9112B PC Board adjustment (October, 2008～)

※ Each PC Board delivered from the factory has already been adjusted.



**This adjustment has to be done after connecting all connectors completely.
Actual x-ray exposure is not necessary.**

1. Adjustment of FQ1

Adjust frequency between FQ1 (+) and GND (–) to be 125 kHz \pm 10% by turning VR5.

230V unit is adjust to 125kHz.

Turning clockwise increases frequency.

2. Confirmation of FQ2

Confirm if frequency between FQ2 (+) and GND (–) is 90 kHz \pm 10%.

3. Set VR6 (EP set) and VR7 (IP set) to the center position.

4. Adjustment of VR1 (pre-heat adjustment under 60kV).

Turning clockwise increases voltage.

Adjust voltage between PRE(+) and GND (–) to be 0.40 V by turning VR1

5. Adjustment of VR2(pre-heat adjustment 62 to 70) .

Turning clockwise increases voltage.

Adjust voltage between PRE(+) and GND (–) to be 0.39 V by turning VR2

6. Adjustment of VR3(pre-heat adjustment 72 to 80kV) .

Turning clockwise increases voltage.

Adjust voltage between PRE(+) and GND (–) to be 0.37 V by turning VR3

7. Adjustment of VR4(pre-heat adjustment 82 to 100kV) .

Turning clockwise increases voltage.

Adjust voltage between PRE(+) and GND (–) to be 0.36 V by turning VR4

7.0 Re-Adjustment of kV



**This adjustment has to be done after connecting all connectors completely.
Actual x-ray exposure is necessary.
This adjustment requires that an exposure be made.
Please observe all radiation related safety precautions.**



**Confirmation is surely necessary after the re-adjustment of kV.
Direct kV test is necessary using kV test instrument such as the VICTOREEN
NERO.**

※This adjustment should be done whenever Insert Box or Inverter PC Board (M9111 PCB) is replaced.

Oscilloscope (with storage mode) : Connect CH1 probe to EP, CH2 probe to IP, and GND to GND terminal on M9112 PC Board. (refer page 12)
M9112B PC Board. (refer page 13)

Setting of oscilloscope: CH1 ; 1.0 V/div, CH2 ; 500m V/div, 10 msec/div

Setting of x-ray output : 0.2 sec., 70 kV, 35mA

Place of adjustment : VR4(M9112), VR6(M9112B) refer page 12 or 13
(kV is increase by turning clockwise.)

Method of adjustment : Measure x-ray tube voltage by oscilloscope and adjust average of peak values of EP waveform to be 3.45 V by VR4(VR6).
After the adjustment is finished, set x-ray output to be 100kV and adjust again so that average of peak values of EP waveform to be 4.9 V.



**When x-ray tube voltage is measured by non - invasive direct x-ray measuring equipment such as NERO, approx. 3 kV of deviation is included.
Therefore, adjust kV to be 97.5 ~ 99 kV at 80 kV station.**

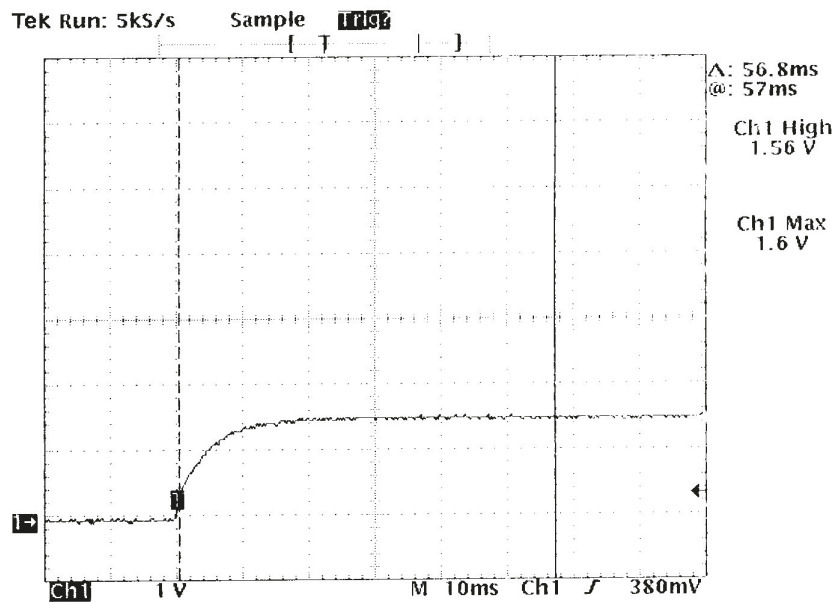


It is necessary to measure the actual kV with a direct x-ray measuring Equipment such as NERO for the confirmation after this adjustment.

7-1. Adjustment of 30 kV by VR4(VR6)

Adjust the ch1 (EP) by VR4(VR6) to be $1.4 \text{ V} \pm 0.05 \text{ V}$.

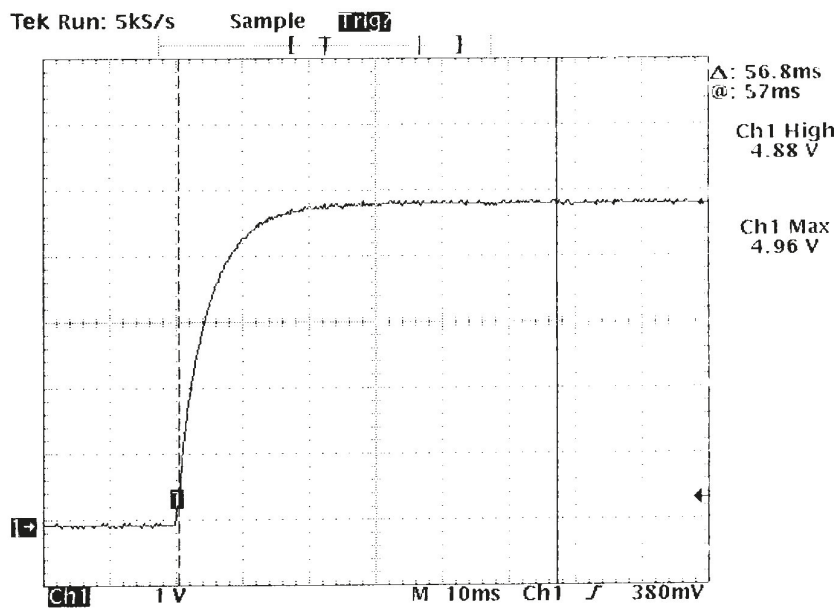
Turning clockwise increases kV.



7-2. Adjustment of 100 kV by VR4(VR6)

Adjust the ch1 (EP) by VR4(VR6) to be $4.9 \text{ V} \pm 0.05 \text{ V}$.

Turning clockwise increases kV.



8. 0 Re-Adjustment of mA



**This adjustment has to be done after connecting all connectors completely.
Actual x-ray exposure is necessary.
This adjustment requires that an exposure be made.
Please observe all radiation related safety precautions.**

※This adjustment should be done whenever Insert Box or Inverter PC Board (M9111 PCB) is replaced.

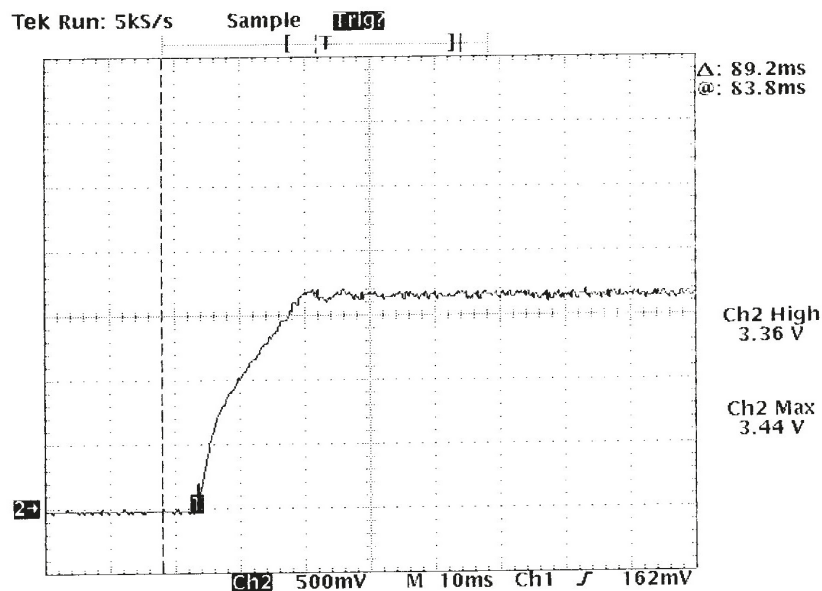
Oscilloscope (with storage mode) : Connect CH1 probe to EP, CH2 probe to IP, and GND to GND terminal on M9112 PC Board. (refer page 12)
M9112B PC Board. (refer page 13)

Setting of oscilloscope : CH1 ; 1.0 V/div, CH2 ; 500m V/div, 10 msec/div

Setting of x-ray output : 0.2 sec., 60 kV, 40mA

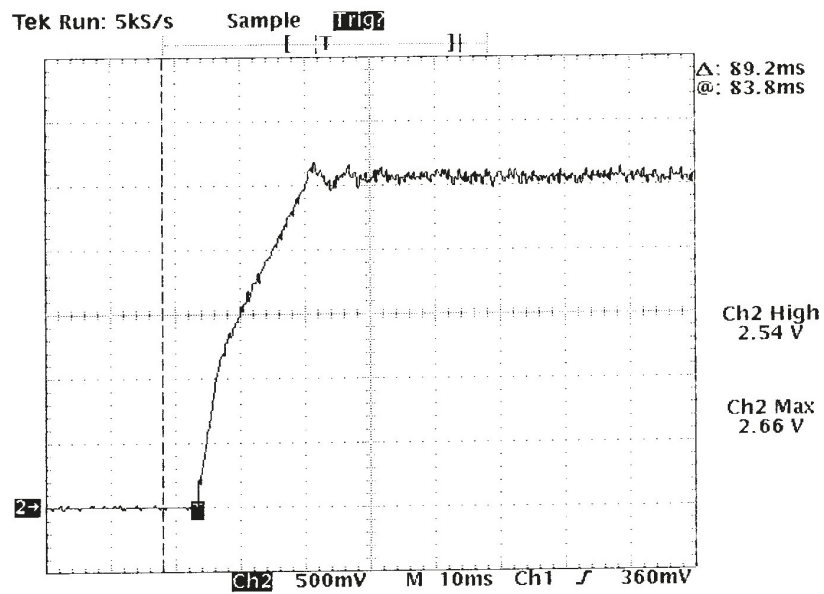
Place of adjustment : VR5(M9112), VR7(M9112B) refer page 12 or 13
(mA is increase by turning clockwise.)

8-1.Adjust average of peak values of IP waveform to be 4.0 V(3.9 to 4.0V).



8-2. Adjustment of 25mA at 100kV by VR5(VR7)

Adjust the ch2 (IP) by VR5(VR7) to be $2.50\text{ V} \pm 0.05\text{ V}$. Turning clockwise increases mA.



9.0 Re-Adjustment of Pre-heat value for M9112

*Keep in mind that the output currents differ in 120V and 230V.



**This adjustment has to be done after connecting all connectors completely.
Actual x-ray exposure is necessary.
This adjustment requires that an exposure be made.
Please observe all radiation related safety precautions.**

※This adjustment should be done whenever Insert Box or Inverter PC Board (M9111 PCB) is replaced.

Oscilloscope (with storage mode) : Connect CH1 probe to EP, CH2 probe to IP, and GND to GND terminal on M9112B PC Board. (refer page 12)

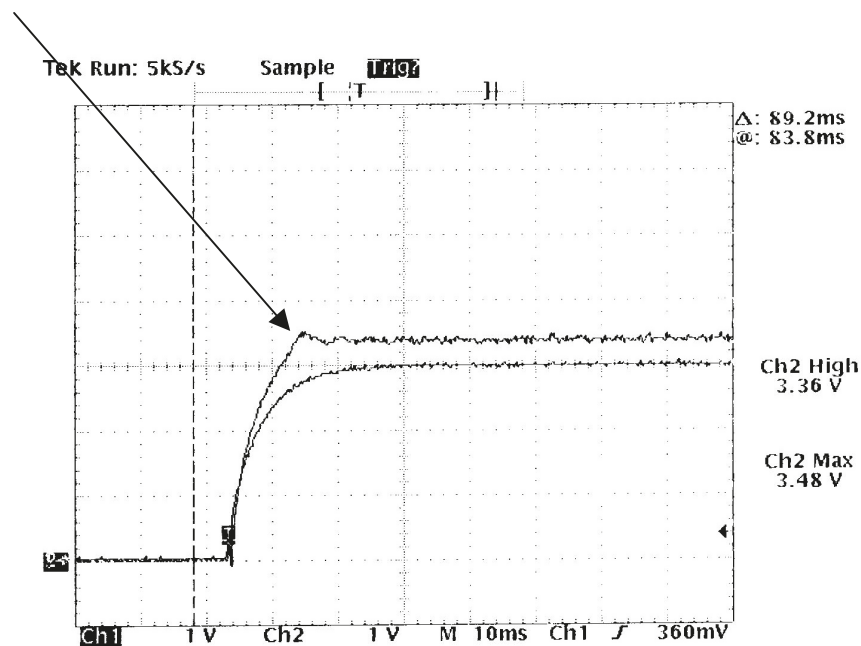
Setting of oscilloscope : CH1 ; 1.0 V/div, CH2 ; 1.0 V/div, 10 msec/div

Setting of x-ray output : 0.2 sec., 60 kV, 40mA

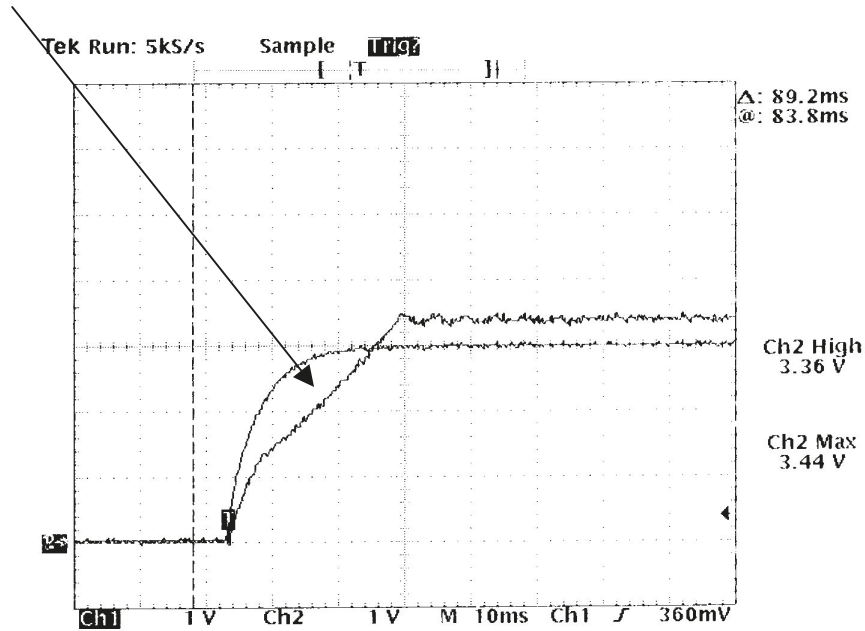
Place of adjustment : VR1 (Pre-heat voltage)

9-1.Adjust peak values of IP waveform to be 4.0 V at 60kV by VR1.

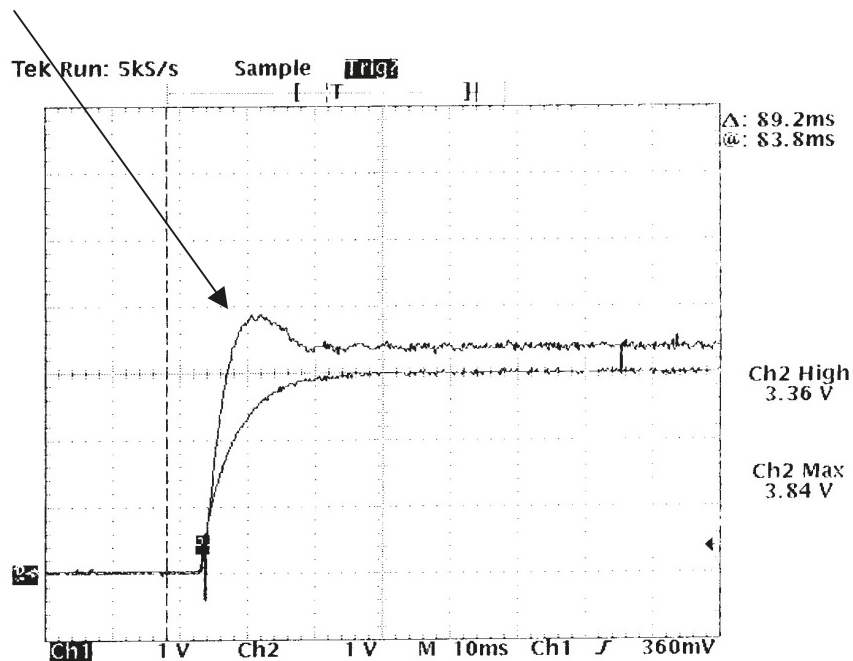
1. Pre-heat value is appropriate.



2. **Pre-heat value is low.** Make Pre-heat value increase by turning VR1 clockwise.



3. **Pre-heat value is high.** Make Pre-heat value decrease by turning VR1 counterclockwise.



9-2. Adjust peak values of IP waveform to be 2.5 V at 100kV by VR5.

Adjust of the Pre-heat value at 25mA by VR3 in the same procedure as a the above

Re-Adjustment of Pre-heat value for M912B

*Keep in mind that the output currents differ in 120V and 230V.



**This adjustment has to be done after connecting all connectors completely.
Actual x-ray exposure is necessary.
This adjustment requires that an exposure be made.
Please observe all radiation related safety precautions.**

※This adjustment should be done whenever Insert Box or Inverter PC Board (M9111 PCB) is replaced.

Oscilloscope (with storage mode) : Connect CH1 probe to EP, CH2 probe to IP, and GND to GND terminal on M9112 PCB Board. (refer page 13)

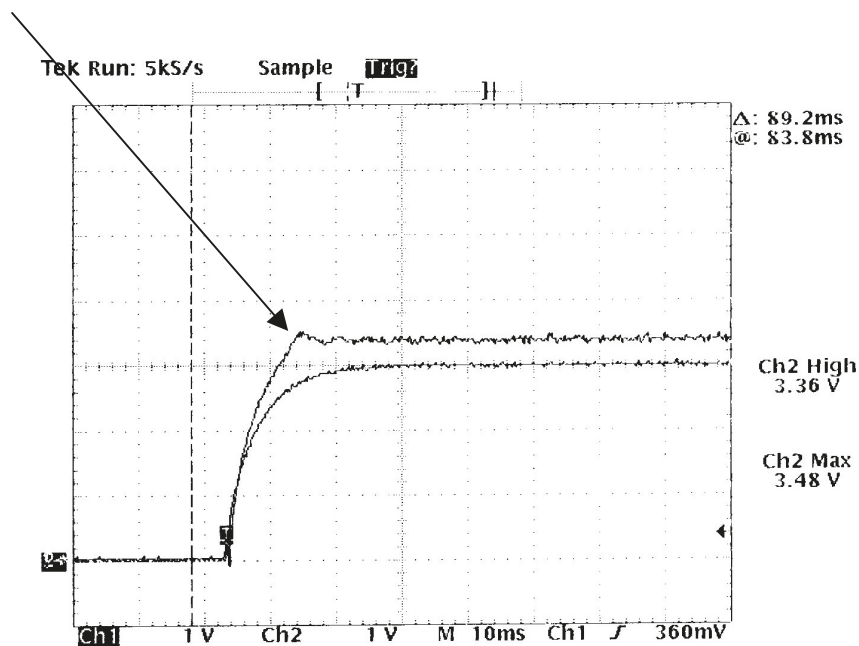
Setting of oscilloscope : CH1 ; 1.0 V/div, CH2 ; 1.0 V/div, 10 msec/div

Setting of x-ray output : 0.2 sec., 60 kV, 40mA

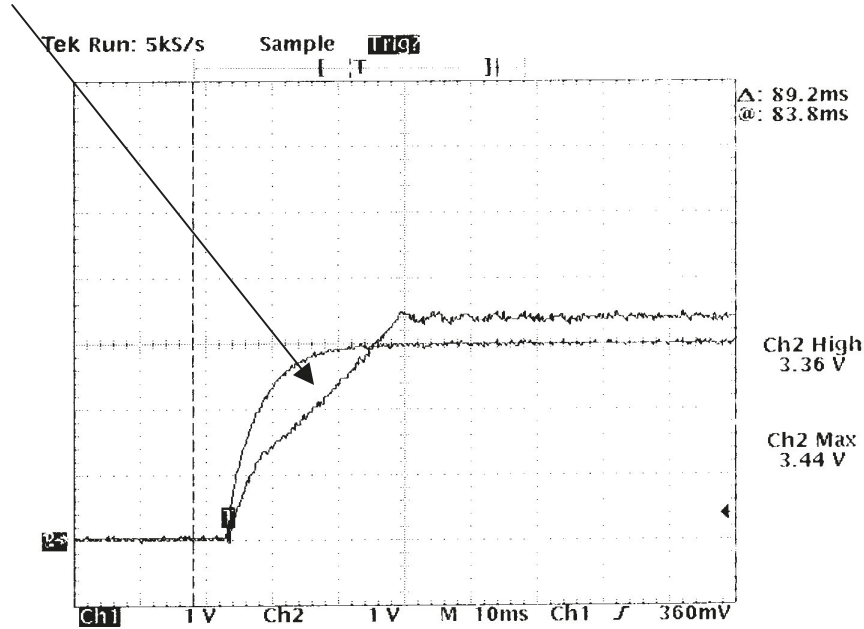
Place of adjustment : VR1 (>37.8mA)

9-1.Adjust peak values of IP waveform to be 4.0 V at 60kV by VR1.

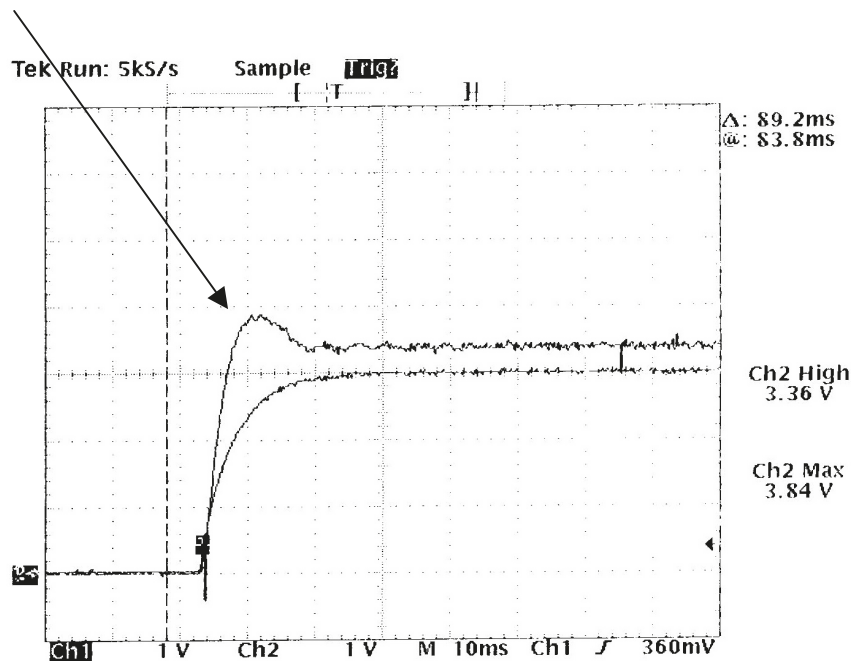
1. Pre-heat value is appropriate.



2. **Pre-heat value is low.** Make Pre-heat value increase by turning VR1 clockwise.



3. **Pre-heat value is high.** Make Pre-heat value decrease by turning VR1 counterclockwise.



9-2. Adjust of the Pre-heat value at 70kV by VR2 in the same procedure as a the above

9-3. Adjust of the Pre-heat value at 80kV by VR3 in the same procedure as a the above

9-4. Adjust of the Pre-heat value at 100kV by VR4 in the same procedure as a the above

13.0 STANDARD TEST DATA

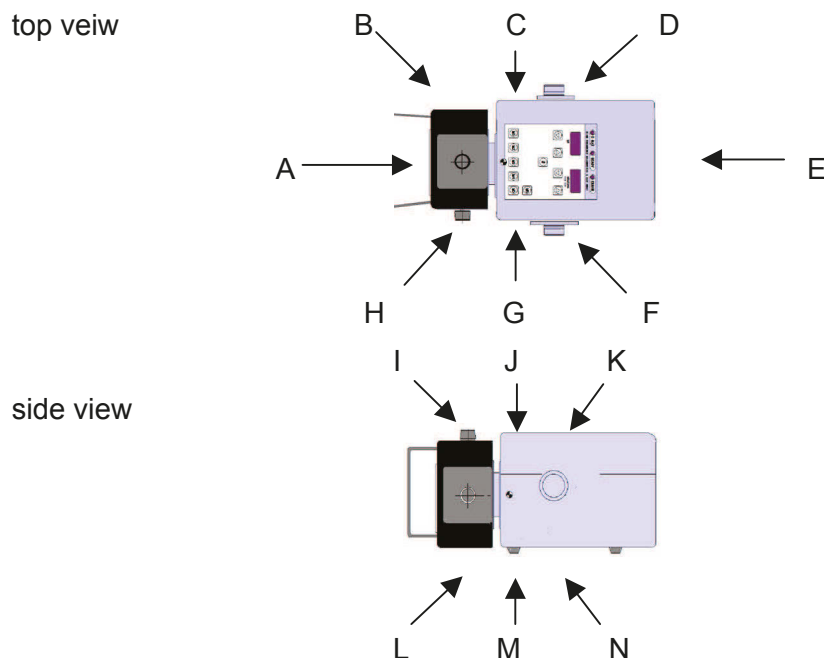
LEAKAGE RADIATION

a. Test method:

1. Set kV to 100 kV, and timer to 1.0 sec.
2. Set x-ray dosimeter as following settings.
distance: 1 m, range: 0 – 0.1 mR ionization chamber: 35³ cm
3. Set chamber as following direction.
4. Close collimator set, and make exposure.
5. Measure value of mR.

Calculations: $\text{mR/h} = (\text{raw test data}) \text{ mR} \times 3600 \times (\text{duty cycle}) / 60$

- b. Instruments: Model 37D Portable X-ray dosimeter Serial No. 5 - 6
Manufactured by D. A. Pitman Ltd.,



c. Sample raw test data:

	A	B	C	D	E	F	G
mR	0.008	0.012	0.026	0.016	0.009	0.008	0.042
	H	I	J	K	L	M	N
mR	0.020	0.046	0.030	0.009	0.054	0.018	0.008

d. Calculations: $\text{mR/h} = (\text{raw test data}) \text{ mR} \times 3600 \times (\text{duty cycle}) / 60$

	A	B	C	D	E	F	G
mR/h	0.48	0.72	1.56	0.96	0.54	0.48	2.52
	H	I	J	K	L	M	N
mR/h	1.2	2.76	1.8	0.54	3.24	1.08	0.48

BEAM QUALITY (HVL)

a. Test method:

1. Set kV to 30 kV, and timer to 0.2 sec.
2. Set NERO as following settings.
SID: 18 inches, wheel range: 27 ~ 42 kV, sensitivity: Hi, phase select: 3 ϕ
measurement mode: SGL x-ray values: 30kV, 0.2sec.
3. Make first exposure.
4. Put filter on the detector and make second exposure to NERO..
5. Press HVL button on NERO, input thickness of filter, and press enter.
6. Measure HVL value at 30kV.
7. Measure HVL value at 40kV with same procedure.
8. Set kV to 50 kV, and timer to 0.2 sec.
9. Set NERO as following settings.
SID: 18 inches, wheel range: 50 ~ 85 kV, sensitivity: Low, phase select: 3 ϕ
measurement mode: SGL x-ray values: 50kV, 0.2sec.
10. Measure HVL value at 50kV to 80kV with same procedure.
11. Set kV to 90 kV, and timer to 0.2 sec.
12. Set NERO as following settings.
SID: 18 inches, wheel range: 70 ~ 120 kV, sensitivity: Low, phase select: 3 ϕ
measurement mode: SGL x-ray values: 90kV, 0.2sec.
13. Measure HVL value at 90kV and 100kV with same procedure.

b. Instruments: NERO Model 6000M x-ray beam analyzer serial No.724
Manufactured by Victoreen, Inc.

c. Sample raw test data:

kV setting	HVL
30kV	1.52mAl
40kV	1.58mAl
50kV	1.78mAl
60 kV	1.96mAl
70 kV	2.51mAl
80 kV	3.06mAl
90 kV	3.33mAl
100kV	4.12mAl

REPRODUCIBILITY(C.V.)

a. Test method:

1. Set kV to 100 kV, and timer to 0.01 sec.
2. Set NERO as following settings.
SID: 18 inches, wheel range: 70 ~ 120 kV, sensitivity: Low, phase select: 3 ϕ
measurement mode: STAT x-ray values: 100kV, 0.01sec.
3. Make first exposure.
4. Close collimator, set timer to 0.1 sec., and make another exposure.
5. Open collimator, reset timer to original setting and make second exposure.
6. Continue above 4 and 5 for 10 times with 30 sec. interval between each exposure.
7. Press EXIT button of NERO and print out the result at STAT mode.
8. Measure also at 0.02 sec to 0.1 sec., 0.5, 1.0, 2.0 sec. with same procedure.
Timer setting for each of them for procedure of above 4 is set time plus 0.1 sec.

b. Instruments: NERO Model 6000M x-ray beam analyzer serial No.724
Manufactured by Victoreen, Inc.

c. Sample raw test data:

timer setting	C.V. value
0.01 sec.	0.0218
0.03 sec.	0.0196
0.05 sec.	0.0178
0.07 sec.	0.0015
0.10 sec	0.0023
0.50 sec	0.0049
1.00 sec	0.0003
2.00 sec	0.0008

PEAK TUBE POTENTIAL(kV)

a. Test method:

1. Set kV to 30 kV, and timer to 0.2 sec.
2. Set NERO as following settings.
SID: 18 inches, wheel range: 27 ~ 42 kV sensitivity: Hi, phase select: 3 ϕ
measurement mode: SGL x-ray values: 30kV, 0.2 sec.
3. Make exposure and measure value of avg. kV.
4. Set kV to 40 kV, and timer to 0.2 sec
5. Set NERO as following settings.
SID: 18 inches, wheel range: 35 ~ 60 kV sensitivity: Hi, phase select: 3 ϕ
measurement mode: SGL x-ray values: 40kV, 0.2 sec.
7. Measure avg. kV value at 40kV and 50kV with same procedure.
8. Set kV to 60 kV, and timer to 0.2 sec
9. Set NERO as following settings.
SID: 18 inches, wheel range: 50 ~ 85 kV sensitivity: Hi, phase select: 3 ϕ
measurement mode: SGL x-ray values: 60kV, 0.2 sec.
10. Measure avg. kV value at 60kV to 80kV with same procedure.
11. Set kV to 90 kV, and timer to 0.2 sec
12. Set NERO as following settings.
SID: 18 inches, wheel range: 70 ~ 120 kV sensitivity: Hi, phase select: 3 ϕ
measurement mode: SGL x-ray values: 90kV, 0.2 sec.
13. Measure avg. kV value at 90kV and 100kV with same procedure.

b. Instruments: NERO Model 6000M x-ray beam analyzer serial No.724
Manufactured by Victoreen, Inc.

c. Sample raw test data:

kV setting	kV value
30 kV	39.5kV
40 kV	40.1kV
50 kV	50.4 kV
60 kV	59.6kV
70 kV	69.3kV
80 kV	80.4 kV
90 kV	89.3 kV
100 kV	99.4 kV

TUBE CURRENT(mA)

a. Test method:

1. Set kV to 60 kV, and timer to 0.2 sec.
2. Set oscilloscope as following settings.
ch 1: Ep, ch 2: Ip, ch1 V/div: 500mV, ch2 V/div: 500 mV, sec/div: 25 msec,
3. Connect ch1 of oscilloscope to EP pin of M9142 and connect ch2 of oscilloscope to IP pin of M9112. Connect GND line of probe to GND pin of M9112.
4. Measure Hi value of ch2.
5. Measure Hi value of ch 2 at following kV settings, and timer to 0.2 sec with same procedure.

b. Instruments: Digital oscilloscope TDS310P serial No.J300159
Manufactured by Tectornix , Inc.

c. Sample raw test data:

kV setting	Hi value
60 kV	3.42 V
90 kV	2.51 V

d. Calculations: $\text{mA} = (\text{raw test data}) \text{ V} \times 10$

kV setting	mA value
60 kV	34.2 mA
90 kV	25.1 mA

EXPOSURE TIME(sec)

a. Test method:

1. Set kV to 100 kV and timer to 0.01 sec.
2. Set NERO as following settings.
SID: 18 inches, wheel range: 70 ~ 120 kV sensitivity: Low, phase select: 3 ϕ
measurement mode: STAT x-ray values: 100kV, 0.01 sec.
3. Make exposure and read value of exposure time .
5. Measure value of exposure time at following settings with same procedure.

b. Instruments: NERO Model 6000M x-ray beam analyzer serial No.724
Manufactured by Victoreen, Inc.

c. Sample raw test data

timer setting	measured value
0.01sec.	0.0112 sec
0.03 sec.	0.0308 sec
0.05 sec	0.0512 sec
0.07 sec	0.0704 sec
0.10 sec	0.101 sec
0.30 sec	0.300 sec
0.50 sec	0.501 sec
0.70 sec	0.699 sec
1.00 sec	0.989 sec

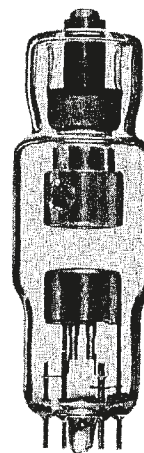
TOSHIBA

Electron Tube, Device & Equipment
TECHNICAL DATA

TOSHIBA X-RAY TUBE D-124,D-124S

STATIONARY ANODE X-RAY TUBE

- ◆ Especially designed for portable X-ray unit.
- ◆ Provided with an insulation cylinder.(D-124S)
- ◆ These tubes have focus 1.2 mm, and are available for maximum tube voltage 100 kV with self-rectified and DC or 110 kV with single phase full-wave rectified circuit.
- ◆ Installed in the same enclosure with the high tension transformer.



GENERAL DATA

ELECTRICAL:

Circuit(Center-grounded)	Self-rectified,Single phase full-wave rectified or DC
Operating Tube Voltage	Self-rectified50 to 100 kV
	Full-wave rectified ...50 to 110 kV
	DC.....50 to 100 kV
Focal Spot.....	1.2 mm
Input Energy(at 1.0s):	
See rating charts.....	Self-rectified 1130 W
	Full-wave rectified 1780 W
	DC..... 2400 W

MECHANICAL:

Dimensions	See dimensional outline.
Overall Length:	
D-124	111 mm
D-124S	130 mm
Max. Diameter:	
D-124	41 mm
D-124S	48 mm

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TOSHIBA CORPORATION
EDISON, CALIFORNIA

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