

MINXRAY^{INC.®}

MINXRAY *HF100+*

PORTABLE VETERINARY X-RAY UNIT

SERVICE MANUAL

Version 1.6

This manual is established for repair and adjustment of MinXray HF100+ portable veterinary x-ray unit. It prohibits the other company from transferring and/or perusing without consent of mikasa x-ray co., ltd.

EDITOR

Mikasa x-ray co., ltd.

5-10-5 Koishikawa 5-Chome
Bunkyo-Ku, Tokyo 112-0002 Japan

Tel: +81-3-3811-6958

Fax: +81-3-3814-7844

E-mail: info@mikasax-ray.com

CONTENTS

1. INTRODUCTION
2. NOTICE FOR SAFE OPERATION
3. SPECIFICATIONS
4. TROUBLESHOOTING
5. MAINTENANCE
6. RE-ADJUSTMENT OF PC BOARD
7. RE-ADJUSTMENT OF kV
8. RE-ADJUSTMENT OF mA
9. RE-ADJUSTMENT OF PRE-HEAT VALUE
10. RE-ADJUSTMENT OF EXPOSURE TIME
11. BLOCK WIRING DIAGRAM

DEVICE HISTORY (refer to mikasa website: <http://www.mikasax-ray.com/>)

1. INTRODUCTION

This service manual is for **MinXray HF100+** portable veterinary x-ray unit.

If you have any questions or need further assistance, please contact us. We have available Monday – Friday, 8:30 – 17:00 central time

Service Department
MinXray, Inc.
3611 Commercial Avenue
Northbrook, Illinois 60062-1822
U.S.A.
Tel: 1-847-564-0323
Toll free tel: 1-800-221-2245 (U.S. and Canada)
Fax: 1-847-564-9040
E-mail: service @ minxray.com
Internet: www.minxray.com

The **MinXray HF100+** is a constant potential portable x-ray device utilizing the latest high frequency resonant inverter system. This x-ray unit has the following features:

1. This x-ray unit is very easy to carry by hand because of its small size and light weight.
2. Input line voltage of this x-ray unit is a world wide range of 110VAC – 240VAC, 50/60Hz.
3. Dual Laser Pointers in the light beam collimator are easy to adjust to indicate the central ray at your typical source-to-image distance (SID).
4. A high frequency resonant inverter with output greater than conventional models and constant x-ray tube voltage.
5. Output of kV and mA are corrected and stabilized by automatic feedback circuits.
6. Compared with conventional generators, the waveform can be more than 2.5 times as effective.
7. Focal spot size of x-ray tube is 1.2mm. Therefore, the quality of the resultant radiographs is better than x-ray taken by units with larger focal spots.
8. It is easy to select either exposure time or mAs display on the control panel.

9. The last kV and timer settings before the unit is turned off are stored for the next operation.






10. Five different technique setting can be stored in memory for quick recall on this x-ray unit.




WARNING: As the **MinXray HF100+** uses high voltage, please read this manual carefully prior to operation.

2.0 NOTICE FOR SAFE OPERATION

1. The following safety symbols will be used in this manual.

	WARNING:	This symbol is warning about the possibility of injury of patient or operator.
	CAUTION:	This symbol is caution for the possibility of product failure.
	NOTE:	This symbol is note for operating this product correctly.
	WARNING: RADIATION HAZARD:	This symbol warns of a possible radiation hazard.
	DANGEROUS VOLTAGE:	This symbol is caution for the possibility of electric shock.

2. The **MinXray HF100+** is not certified for human use.
3. During operation, the operator should be fully protected from exposure to radiation and use a dosimeter badge.
4. The **MinXray HF100+** has been developed specially for veterinary x-ray applications. It should not be used for other applications.
5. X-ray equipment should be operated only by individuals who have appropriate training and licenses.

	WARNING: This x-ray unit may be dangerous to patient and operator unless safe exposure factors, operating instructions and maintenance schedules are observed.
---	---

6. Please take the following precautions during installation:
- A) Keep equipment dry.
 - B) Do not subject equipment to excessive atmospheric pressure, temperature, humidity, direct sunlight, dust, or air containing salt and sulphur.
 - C) Do not subject equipment to excessive vibration and/or shock during transportation, etc.
 - D) Do not store equipment under any adverse gaseous conditions.
 - E) Insure that the input electrical voltage, amperage and hertz are correct and the unit is properly grounded.

7. During operation, consult and/or develop a technique chart for appropriate anatomy, distance, and screen/film or digital imaging system speed.

8. After using the equipment:

- A) Remove cords carefully, if necessary.
- B) Keep equipment clean and dry.
- C) Store inside carrying case in cool, dry environment.

9. Maintenance

For proper maintenance, this schedule must be followed:

A) Every 6 months

- 1) Check the alignment of the collimator light field with the x-ray beam.
- 2) Check the audible and visible exposure functions.
- 3) Check to see that all bolts, screws and lock nuts are tight.
- 4) Re-adjust the position of laser beams to be aligned with the central ray of the x-ray unit at the source-to image-distance (SID) you typically use.

B) Every 2 years

- 1) Replace the collimator bulb.



WARNING: TO INSTALLERS, SERVICE PERSONNEL, AND USERS OF X-RAY SYSTEMS RE EQUIPMENT MOUNTING SECURITY. When performing periodic maintenance, calibration, or changing of the components of an x-ray system, the person in charge should confirm whether all components and screws are properly connected and securely tightened. Continued use of loose components is dangerous and could cause further loosening, damage of screws and bolts, or mount failure which could result in HEAVY COMPONENTS FALLING DURING USE. The operator should report all loose system components to x-ray service personnel for immediate repair.

It is especially advised to check the security of the collimator mounting screws. This can be accomplished easily by grasping the collimator and attempting to move it in relation to the x-ray unit. The system should also be inspected for loose joints, not only between the collimator and tubehead/control, but other mounting areas as well.

The four (4) collimator mounting screws must engage the collimator mounting ring. If inspection reveals loose collimator mounting screws at an installation, or as a precautionary measure at any installation, it is suggested that a medium strength thread locking glue such as LOCTITE #242 or PERMA-LOK MM-115 be used after first cleaning the screw with alcohol.

3. SPECIFICATIONS

Rating

Power Requirement:	AC, single phase, 110 V – 240 V, 3.5 kVA, 50 / 60 Hz (Check rating label on x-ray unit.)
Line voltage regulation:	4.5 %
Apparent resistance of supply mains:	0.18 ohms @ 120 VAC , 0.52 ohms @ 230 VAC
Maximum standby input current:	0.20 A @ 230 VAC
Maximum input current:	28 A @ 100 kVDC, 120 VAC 14 A @ 100 kVDC, 230 VAC
Line circuit breaker:	30 A @ 120 VAC , 15 A @ 230 VAC
Protection against electrical shock:	Type B Class 1
Mode of operation:	Continuous operation with intermittent loading
Duty cycle:	1:60 (one 0.2 second exposure every 12 seconds)
Fuse:	20 A @ 250 VAC

Beam Limiting Device

Model number:	R-200V type:L03
Manufacturer:	Mikasa X-ray Co., Ltd.
Inherent filtration:	0.5 mm Al

Laser Pointers

Model number:	LP4
Laser type:	Class IIIa Laser Diode
Maximum output:	< 3.0 mW
Wavelength:	635 nm
Beam length:	16.5 mm at 60 cm
Power:	12 VDC

Dimensions And Accessories

Equipment size (X-ray Generator):	W: 240mm x H: 196mm x L: 365mm (9.5" x 7.75" x 14.4")
Weight:	11kgs (24.25 lbs.)
Exposure switch cord:	HS-M1 (Two-stage, deadman with RJ11 connector)
Size:	8 feet (2.44 meters)
Detachable power cord:	Connect to 3-wire systems, one wire grounded.
Size:	16AWG up to 20 feet (6.1 meters)

Environmental Conditions For Use

Temperature:	+10 °C to +40 °C (50 °F to 104 °F)
Humidity:	30 % to 75 %, excluding condensation

Atmospheric Pressure:	700 hPa to 1060 hPa
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:	500 hPa to 1060 hPa

X-ray Generator

Generator system:	60 kHz resonate high frequency inverter system
Electric power:	2.1 kW @ 70 kVDC, 30 mA
Tube voltage:	tolerance +/-10 % range: 40 kVDC – 100 kVDC kV switch : 2 kV step
Tube current:	tolerance +/-10 % range: 40 mA @ 40 kVDC – 50 kVDC 35 mA @ 52 kVDC – 60 kVDC 30 mA @ 62 kVDC – 70 kVDC 25 mA @ 72 kVDC – 80 kVDC 20 mA @ 82 kVDC – 100 kVDC
Exposure timer:	tolerance +/- (10 % + 1 msec) range: 0.01 sec – 0.4 sec : 0.01 sec step 0.4 sec – 1.0 sec : 0.02 sec step 1.0 sec – 1.5 sec : 0.05 sec step 1.5 sec – 2.0 sec : 0.10 sec step
Leakage technique factors:	0.33 mA @ 100 kV 0.33 mA is maximum rated continuous current for 20mA with duty cycle 1:60
Filtration:	inherent filtration : 2.4 mmAl total filtration : 2.9 mmAl (with beam limiting device)

X-ray Tube

Model number:	D-124
Manufacturer:	TOSHIBA CORPORATION
Focal spot:	1.2 mm
Target material:	tungsten
X-ray tube target angle:	16 degrees
X-ray tube inherent filtration:	at least 0.8 mm Al
Anode heat storage capacity:	20 kHU

Specification subject to revision without notice.

4. TROUBLESHOOTING

This x-ray unit has self-diagnostic indications of failure or malfunction. If the following SYMPTOM is displayed, stop exposing and follow the CORRECTIVE ACTION described below. The unit has malfunctioned and x-ray cannot be generated.

SYMPTOM : Error Indicator is lit

CORRECTIVE ACTION:

- 1) Turn off the main power switch, and turn on again after 60 or more seconds.
- 2) If the Error Indicator does not remain on, please check Power Supply in PRECAUTIONS IN USE again.
- 3) If the Error Indicator remains on, contact your dealer or MinXray for service.

Countermeasure (s) :

- a) Check the power cord whether it is defective.
- b) Check All connectors whether it are connected completely.
- c) Check some components on MT1001A and MT2001A whether it are defective.
- d) Check the OCP value on MT2001A.
- e) Exchange the PC board MT2001A

SYMPTOM : Error Indicator is blink

CORRECTIVE ACTION:

- 1) If the exposure switch is released before the set exposure time, Error Indicator will blink.
- 2) To reset the Error Indicator, turn off the main power switch, and turn on again after 60 or more seconds.
- 3) If the Error Indicator remains on, contact your dealer or MinXray for service.

SYMPTOM : Fuse(s) is/are blown

CORRECTIVE ACTION:

- 1) Check Power Supply in PRECAUTIONS IN USE (page 8).
- 2) Remove the power cord.
- 3) Open the fuse box in the ac inlet.
- 4) Remove defective fuses, and replace to new one. If it is difficult to remove defective fuses, use tools with tip sharpened.
- 5) Turn on the main power switch, and check operations again.
- 6) If the fuse(s) is/are blown again, contact your dealer or MinXray for service.

Countermeasure (s) :

- a) Check the power cord whether it is defective.
- b) Check All connectors whether it are connected completely.
- c) Check some components on MT1001A and MT2001A whether it are defective.

SYMPTOM : Exposure time Indicator displays "A".

CORRECTIVE ACTION:

- 1) Turn off the main power switch, and turn on again after 60 or more seconds.
- 2) If the "A" remain on, please contact your dealer or MinXray for service.

Countermeasure (s) :

- a) Exchange the PC board M2300.
The defect of the primary CPU on M2300.

SYMPTOM : Exposure time Indicator displays "C".

CORRECTIVE ACTION:

- 1) Turn off the main power switch, and turn on again after 60 or more seconds.
- 2) If the "C" remain on, please contact your dealer or MinXray for service.

Countermeasure (s) :

- a) Exchange the PC board M2300.
The defect of the primary CPU on M2300.

SYMPTOM : Exposure time Indicator displays "1".

CORRECTIVE ACTION:

- 1) Turn off the main power switch, and turn on again after 60 or more seconds.
- 2) If the "1" remain on, please contact your dealer or MinXray for service.

Countermeasure (s) :

- a) Exchange the PC board M2300.
The defect of the primary CPU on M2300.

SYMPTOM : Exposure time Indicator displays "ERR".

CORRECTIVE ACTION:

- 1) Turn off the main power switch, and turn on again after 60 or more seconds.
- 2) If the "ERR" remain on, please contact your dealer or MinXray for service.

Countermeasure (s) :

- a) Exchange the PC board M2300.
The defect of the primary CPU on M2300.

SYMPTOM : mAs indicator and sec indicator are both lit.

CORRECTIVE ACTION:

- 1) Turn off the main power switch, and turn on again after 60 or more seconds.
- 2) If the indicators remain on, please contact your dealer or MinXray for service.

Countermeasure (s) :

- a) Exchange the PC board M2300.
The defect of the secondary CPU on M2300.

SYMPTOM : mAs indicator and sec indicator are lit alternately.

CORRECTIVE ACTION:

- 1) Turn off the main power switch, and turn on again after 60 or more seconds.
- 2) If the indicators remains on, please contact your dealer or MinXray for service.

Countermeasure (s) :

- a) Exchange the PC board M2300.
The defect of the secondary CPU on M2300.

SYMPTOM : Control panel display does not illuminate.

CORRECTIVE ACTION:

- 1) Turn off the main power switch, and turn on again after 60 or more seconds.
- 2) If the control panel display does not illuminate, contact your dealer or MinXray for service.

Countermeasure (s) :

- a) Check the power cord whether it is defective.
- b) Check All connectors whether it are connected completely.
- c) Check some components on MT1001A and MT2001A whether it are defective.
- d) Exchange the PBA100F-12.

5. MAINTENANCE

GENERAL INFORMATION

The unit is adjusted in the factory, therefore adjustment should be unnecessary. However, if you replace the circuit boards or check the unit for maintenance, please adjust by the following procedures. If these checks and adjustment are not performed, the compliance with regulations cannot be assured.

1. Remove outer case.



SHOCK HAZARD: Dangerous voltages are present on the circuit boards inside the unit. Turn off the power switch of the unit and pull out power cord from wall. Allow 10 minutes for large capacitors to safety discharge.

2. Replacement and adjustment



CAUTION: All parts for replacement should be used the specified parts.



WARNING: Be sure all connectors are properly connected, before adjustment of the circuit boards.



CAUTION: Maintenance and adjustments should be adjusted according to each procedures.

6. RE-ADJUSTMENT OF PC BOARD

6.1 MT1001A (1b) PC Board adjustment



CAUTION: 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 SGND(-)* to be 120kHz turning VR2.

Turning clockwise increases frequency.

2. Adjustment of FQ2

Adjust frequency between FQ2(+) and SGND(-) to be 90kHz turning VR7.

Turning clockwise increases frequency.

3. Set VR1 (EP set) to the center position.

4. Set VR6 (IP set) to the center position.

5. Adjustment of VR3H (pre-heat adjustment under 50kV).

Adjust voltage between PRE(+) and SGND(-) to be **0.46V** by turning VR3H

Turning clockwise increases voltage.

6. Adjustment of VR5L (pre-heat adjustment 52 to 70kV).

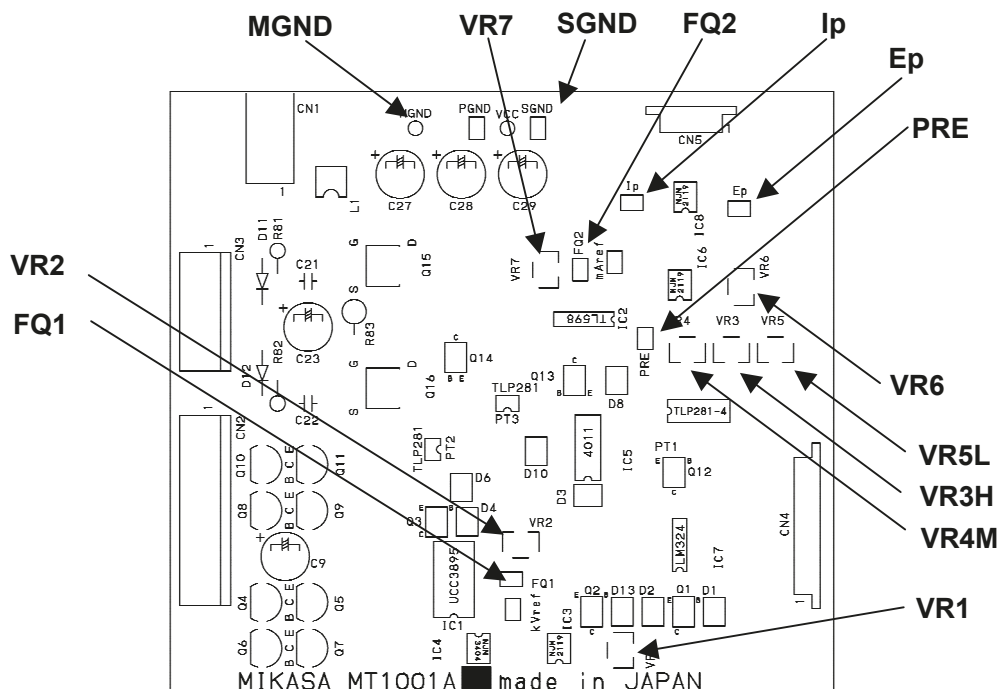
Adjust voltage between PRE(+) and SGND(-) to be **0.44V** by turning VR5L

Turning clockwise increases voltage.

7. Adjustment of VR4M (pre-heat adjustment 72 to 100kV).

Adjust voltage between PRE(+) and SGND(-) to be **0.42V** by turning VR4M

Turning clockwise increases voltage.



*(+): measurement probe

(-): grand probe

6.2 MT2001B (1b) PC Board adjustment



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

1. Adjustment of FQ

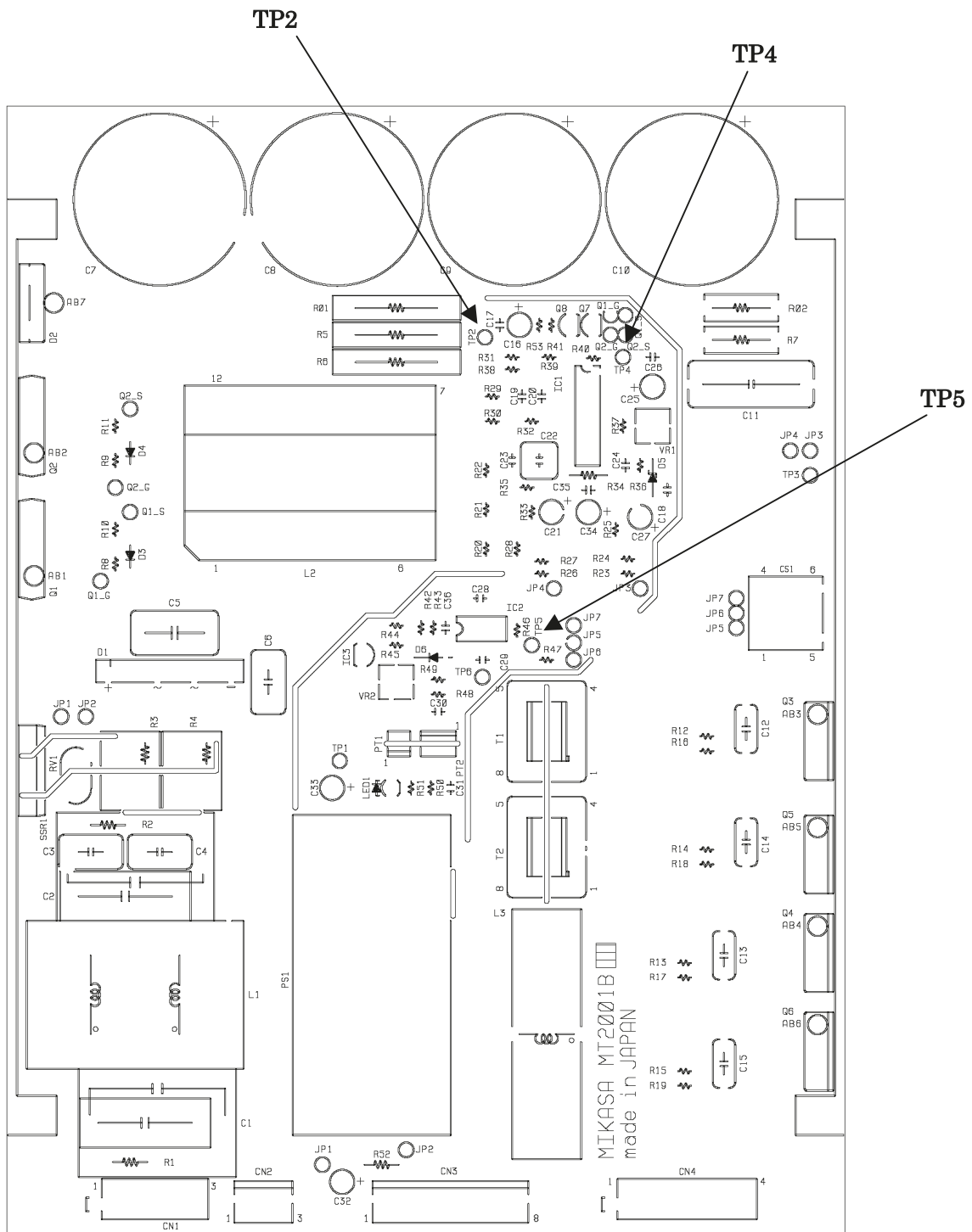
Adjust frequency between TP4 (+) and TP2 (-)* to be **40kHz** turning VR1.

Turning clockwise increases frequency.

2. Adjustment of OCP

Adjust frequency between TP5 (+) and TP2 (-) to be **4.9V** turning VR2.

Turning clockwise increases voltage.



7. RE-ADJUSTMENT OF kV



CAUTION: 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.



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

Measurement tools:

Oscilloscope: Connect CH1 probe to Ep, CH2 probe to Ip, and GND to SGND* terminal on MT1001A PC-board.

Setting:

Oscilloscope storage mode
mode:

range CH1: 1V/div CH2: 1V/div 10msec/div

:

x-ray output: 0.07sec 100kV

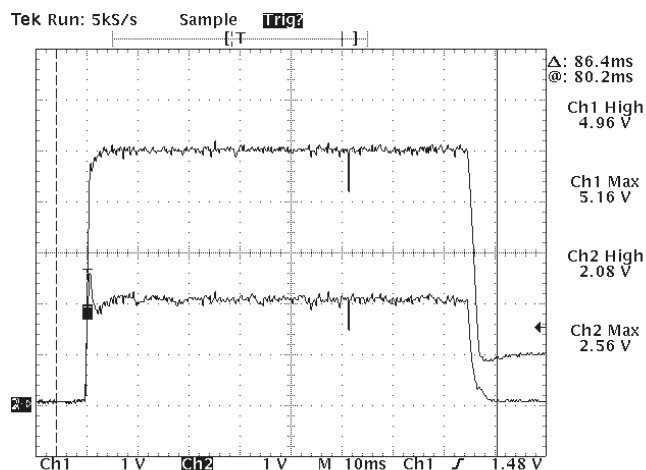
place of adjustment: VR1 on MT1001A PC-board

method of Measure x-ray tube voltage by oscilloscope and adjust average of peak values of Ep
adjustment: waveform to be **4.9V** by VR1.

Adjustment of 100kV by VR1

Adjust the CH1(Ep) by VR1 to be 4.9V +/-0.06V.

Turning clockwise increases voltage.



8. RE-ADJUSTMENT OF mA



CAUTION: 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.

Measurement tools:

Oscilloscope: Connect CH1 probe to Ep, CH2 probe to Ip, and GND to SGND* terminal on MT1001A PC-board.

Setting:

Oscilloscope storage mode

mode:

range CH1: 1V/div CH2:1V/div 10msec/div

:

x-ray output: 0.07sec 50kV

place of adjustment: VR6 on MT1001A PC-board

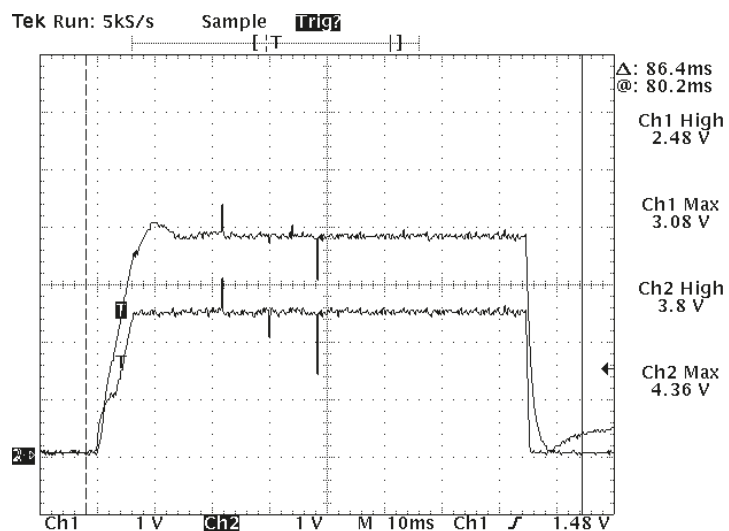
method of Measure x-ray tube voltage by oscilloscope and adjust average of peak values of Ip

adjustment: waveform to be **3.7V** by VR6.

Adjustment of 50kV by VR6

Adjust the CH2(Ip) by VR6 to be **3.7V** -0.06V.

Turning clockwise increases voltage.



9. RE-ADJUSTMENT OF PRE-HEAT VALUE



CAUTION: 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.

Measurement tools:

Oscilloscope: Connect CH1 probe to Ep, CH2 probe to Ip, and GND to SGND* terminal on MT1001A PC-board.

Setting:

Oscilloscope storage mode
mode:

range CH1: 1V/div CH2: 1V/div 10msec/div

:

x-ray output: 0.05sec 70kV
0.05sec 80kV
0.05sec 100kV

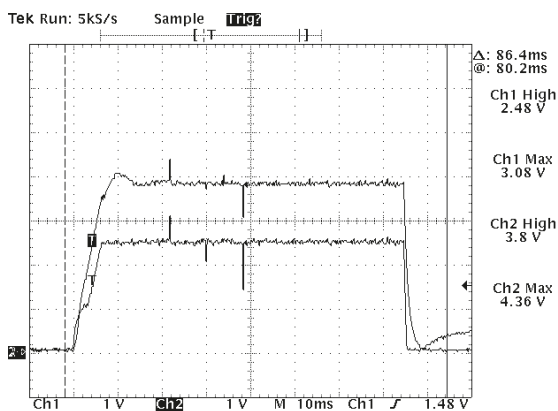
place of adjustment: 1) VR3 on MT1001A PC-board @ 50kV
2) VR5 on MT1001A PC-board @ 70kV
3) VR4 on MT1001A PC-board @ 100kV

method of Measure x-ray tube current 1), 2), 3) by oscilloscope and adjust pre-heat values of
adjustment: Ip waveform to be = 10msec-15msec.

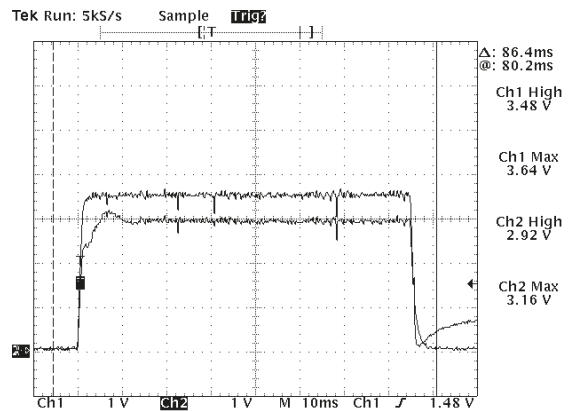
Adjustment of 100kV by VR4, 80kV by VR5, 70kV by VR3.

Adjust the CH2(Ip) by VR4, VR5, VR3 to be = 10msec-15msec.

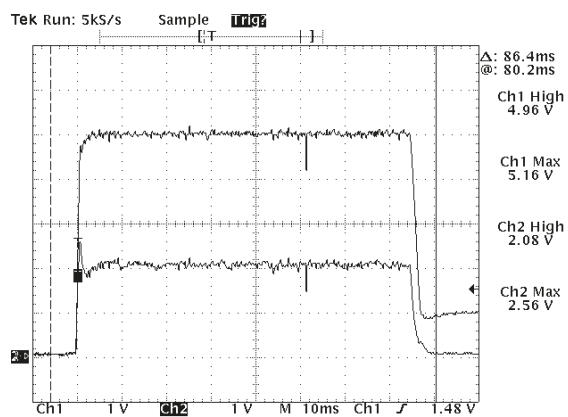
Turning clockwise decreases value (sec).



50kV 40mA



70kV 30mA



100kV 20mA

*If you SGND can not be used, you can also use PGND.

10. RE-ADJUSTMENT OF EXPOSURE TIME



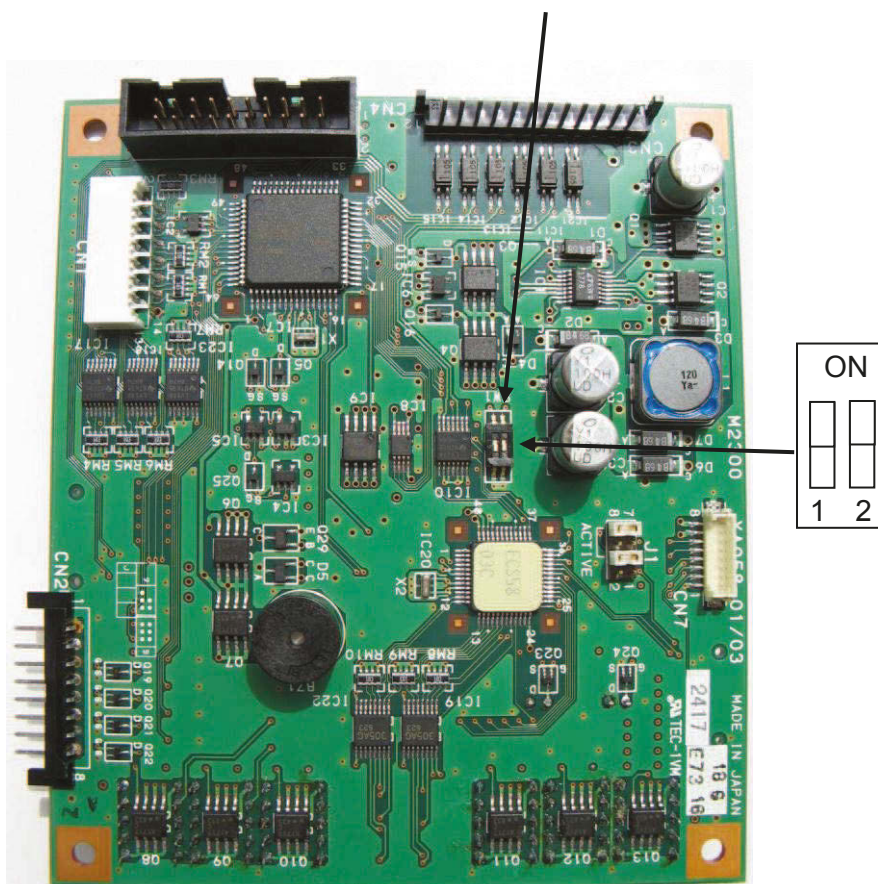
CAUTION: This adjustment has to be done after connecting all connectors completely. Actual x-ray exposure is necessary. This adjustment requires that an exposure be made. Please observe all radiation related safety precautions.

Check the exposure time by using an external exposure time meter such as the VICTOREEN NERO.

The adjustment of the exposure timer is done with a DIPswitch (SW1) on the M2300 board. When SW1 is turned on, an exposure time gets long 0.002 sec for all settings.

✖Remove the battery before you change the setup of DIPswitch.

Turn off a power of unit when you change a DIPswitch.



Additional time:	0.007sec	0.009sec	0.011sec	0.013sec
DIP switch 1:	OFF	OFF	ON	ON
DIP switch 2:	OFF	ON	OFF	ON



CAUTION: The M2300 board for the **MinXray HF100+** is different from M2300 board for other units. CN2 connector is placed on the PC board at different direction.

Information for interface connector

PC BOARD: M2300

Interface connector: CN1		
PIN No.	title	contents
1	GND	Connect with GND
2	M_SW5	Input signal of M5 memory button
3	M_SW4	Input signal of M4 memory button
4	M_SW3	Input signal of M3 memory button
5	M_SW2	Input signal of M2 memory button
6	M_SW1	Input signal of M1 memory button
7	M_SWM	Input signal of memory storage button
8	mAs/sec_up	Input signal of mA/sec Adjustment(+) button
9	mAs/sec_down	Input signal of mA/sec Adjustment(-) button
10	LBD-SW	Input signal of collimator light button
11	shift	Input signal of # button
12	KV_up	Input signal of kV Adjustment(+) button
13	kV_down	Input signal of kV Adjustment(-) button
14	GND	Connect with GND

Interface connector: CN2		
PIN No.	title	contents
1	GND	Connect with GND
2	X_RAY_SW	Input signal of x-ray switch (Normally is 5VDC. It will be set to 0VDC, if the second stage of exposure switch is pushed.)
3	FILLAMENT_SW	Input signal of filament switch (Normally is 5VDC. It will be set to 0VDC, if the first stage and second stage of exposure switch is pushed.)
4	X_RAY_LAMP	Output signal of x-ray lamp (5VDC)
5	FILLAMENT_LAMP	Output signal of filament lamp (5VDC)
6	BUZZER_LAMP	None
7	ERROR_LAMP	Output signal of error lamp (5VDC)
8	VCC	Output signal of VCC (5VDC)

Interface connector: CN3

PIN No.	title	contents
1	POWER	VCC (12VDC)
2	GND	Connect with GND
3	BATTERY	Connect with battery (3VDC)
4	EP_OUT	Output voltage of Ep reference (2VDC – 5VDC)
5	IP_OUT	Output voltage of Ip reference voltage (2VDC – 4VDC)
6	GND	Connect with GND
7	KEIHO	Input signal of error (Normally is 12VDC. It will be set to 0VDC, if the error circuit operates.)
8	X_RAY_ON	Output signal of x-ray output (Normally is 12VDC. It will be set to 0VDC, if the second stage of exposure switch is pushed.)
9	X_RAY_OVER	None
10	FILLAMENT_ON	Output signal of filament (Normally is 12VDC. It will be set to 0VDC, if the first stage and second stage of exposure switch is pushed.)
11	LBD_ON	Output signal of collimator light (Normally is 12VDC. It will be set to LOW VOTAGE, if the collimator light switch is pushed.)
12	LBD_ON_DELAY	Output signal of collimator light delay (Normally is 12VDC. It will be set to LOW VOTAGE, if the collimator light switch is pushed.)

PC BOARD: M2101C

Interface connector: JP1		
PIN No.	title	contents
1	kV ref.	Input voltage of Ep reference (2VDC – 5VDC)
2	Ip ref.	Input voltage of Ip reference voltage (2VDC – 4VDC)
3	X-ray	Input signal of x-ray output (Normally is 12VDC. It will be set to 0VDC, if the second stage of exposure switch is pushed.)
4	filament	Input signal of filament (Normally is 12VDC. It will be set to 0VDC, if the first stage and second stage of exposure switch is pushed.)
5	LBD1	Input signal of collimator light (Normally is 12VDC. It will be set to LOW VOTAGE, if the collimator light switch is pushed.)
6	LBD2	Input signal of collimator light delay (Normally is 12VDC. It will be set to LOW VOTAGE, if the collimator light switch is pushed.)
7	Error	Output signal of error (Normally is 12VDC. It will be set to 0VDC, if the error circuit operates.)
8	GND	Connect with GND
9	VCC	VCC (12VDC)
10	NONE	-

Interface connector: JP2		
PIN No.	title	contents
1	VCC	VCC (12VDC)
2	GND	Connect with GND
3	Ip ref.	Input voltage of Ip reference voltage (2VDC – 4VDC)
4	SSR	NONE
5	Error	Output signal of error (Normally is 12VDC. It will be set to 0VDC, if the error circuit operates.)
6	filament	Input signal of filament (Normally is 12VDC. It will be set to 0VDC, if the first stage and second stage of exposure switch is pushed.)
7	X-ray	Input signal of x-ray output (Normally is 12VDC. It will be set to 0VDC, if the second stage of exposure switch is pushed.)
8	kV ref.	Input voltage of Ep reference (2VDC – 5VDC)

Interface connecter: JP3

PIN No.	title	contents
1	Co_lamp1	Connect with collimator (Normally is 0VDC. It will be set to 12VDC, if the collimator light switch is pushed.)
2	Co_lamp2	Connect with collimator (Normally is 0VDC. It will be set to 12VDC, if the collimator light switch is pushed.)

PC BOARD: MT1001A1c

Interface connector: CN1		
PIN No.	title	contents
1	GND	Connect with GND
2	VCC	Connect with VCC (12VDC)

Interface connector: CN2		
PIN No.	title	contents
1	GND	Connect with GND
2	PVCC	VCC (12VDC)
3	SSR	None
4	ERROR	Input signal of error
5	OUTD	Switching waveform voltage (0VDC – 12VDC) for inverter system
6	OUTC	Switching waveform voltage (0VDC – 12VDC) for inverter system
7	OUTA	Switching waveform voltage (0VDC – 12VDC) for inverter system
8	OUTB	Switching waveform voltage (0VDC – 12VDC) for inverter system

Interface connector: CN3		
PIN No.	title	contents
1	C1	Switching waveform voltage (0VDC – 12VDC) for filament power
2	C0	VCC (12VDC)
3	C2	Switching waveform voltage (0VDC – 12VDC) for filament power
4	ERROR	None
5	GND	Connect with GND

Interface connector: CN4

PIN No.	title	contents
1	VCC	VCC (12VDC)
2	GND	Connect with GND
3	mA ref.	Input voltage of Ip reference voltage (2VDC – 4VDC)
4	GND	Connect with GND
5	ERROR	Input signal of error (Normally is 12VDC. It will be set to 0VDC, if the error circuit operates.)
6	PRE-HEAT	Output signal of filament (Normally is 12VDC. It will be set to 0VDC, if the first stage and second stage of exposure switch is pushed.)
7	X-ray	Output signal of x-ray output (Normally is 12VDC. It will be set to 0VDC, if the second stage of exposure switch is pushed.)
8	kV ref.	Input voltage of Ep reference (2VDC – 5VDC)

Interface connector: CN5

PIN No.	title	contents
1	Ep	Feedback input voltage of Ep
2	GND	Connect with GND
3	Ip	Feedback input voltage of Ip

PC BOARD: MT2001B1c

Interface connector: CN1		
PIN No.	title	contents
1	AC (L)	Input AC voltage (110VAC – 240VAC)
2	AC (N)	Input AC voltage (110VAC – 240VAC)
3	GND	Connect with GND

Interface connector: CN2		
PIN No.	title	contents
1	AC (L)	Output AC voltage (110VAC – 240VAC)
2	AC (N)	Output AC voltage (110VAC – 240VAC)
3	GND	Connect with GND

Interface connector: CN3		
PIN No.	title	contents
1	GND	Connect with GND
2	PVCC	VCC (12VDC)
3	SSR	None
4	ERROR	Input signal of error (Normally is 12VDC. It will be set to 0VDC, if the error circuit operates.)
5	OUTD	Switching waveform voltage (0VDC – 12VDC) for inverter system
6	OUTC	Switching waveform voltage (0VDC – 12VDC) for inverter system
7	OUTA	Switching waveform voltage (0VDC – 12VDC) for inverter system
8	OUTB	Switching waveform voltage (0VDC – 12VDC) for inverter system

Interface connector: CN4		
PIN No.	title	contents
1	T2	Rectangular wave voltage (-370VDC – 370VDC) for kV power
2	NONE	-
3	T1	Rectangular wave voltage (-370VDC – 370VDC) for kV power
4	NONE	-

PC BOARD: M9150A

Interface connector:		
PIN No.	title	contents
1	IP	Feedback output voltage of Ip
2	GND	Connect with GND
3	EP	Feedback output voltage of Ep
4	C2	Switching waveform voltage (0VDC – 12VDC) for filament power
5	C0	VCC (12VDC)
6	C1	Switching waveform voltage (0VDC – 12VDC) for filament power
7	T2	Rectangular wave voltage (-370VDC – 370VDC) for kV power
8	T1	Rectangular wave voltage (-370VDC – 370VDC) for kV power

PC BOARD: M2314

Interface connector:		
PIN No.	title	contents
1	READY_REQ(+)	If Making filament is readied, it is become continuity the between READY_REQ(+) and READY_REQ(-). The rated input is 60 VDC(max) and 50 mA(max).
2	READY_REQ(-)	
3	REMOTE SW	If DR system used, this 3 and 4 pin should be shorted.
4	REMOTE SW	
5	X-RAY_REQ(+)	If Making exposure is readied, it is become continuity the between X-RAY_REQ(+) and X-RAY_REQ(-). The rated input is 60 VDC(max) and 50 mA(max).
6	X-RAY_REQ(-)	
7	X-RAY_COM(+)	This pin is outputted 5 VDC(max) and 20 mA(max) for making x-ray actually.
8	X-RAY_COM(-)	