



HF8020

SERVICE MANUAL

Ver. 1.0 (August 2013)

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GLOBE Co., Ltd.

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1.0 INTRODUCTION

This service manual is for the **MinXray HF8020** portable veterinary x-ray unit.

If you have any questions or need further assistance, please contact us. We are available Monday - Friday, 9:00 - 17:00 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 | August 6, 2013 | 1st-production (10 sets) | 36877 |

3.0 SPECIFICATIONS

120V unit

| | | | | | |
|---------|-----------------------------------|-------|--------------|-------------|-------------|
| POWER : | Range | ----- | 100 ~ 130VAC | | |
| | Minimum voltage with no load | ----- | 100VAC | | |
| | Maximum voltage with no load | ----- | 130VAC | | |
| | Frequency | ----- | 50/60Hz | | |
| | | | | Minimum | Maximum |
| | Electricity consumption | ----- | 120V | 19.0A(50kV) | 25.0A(80kV) |
| | Maximum voltage consumption | ----- | 3.0kVA | $\pm 10\%$ | |
| | Line Voltage regulation | ----- | 4.8% | | |
| | Leakage current: Normal condition | | 0.363mA | | |
| | Single fault condition | | 0.698mA | | |

230V unit

| | | | | | |
|---------|-----------------------------------|-------|--------------|-------------|-------------|
| POWER : | Range | ----- | 200 ~ 260VAC | | |
| | Minimum voltage with no load | ----- | 200VAC | | |
| | Maximum voltage with no load | ----- | 260VAC | | |
| | Frequency | ----- | 50/60Hz | | |
| | | | | Minimum | Maximum |
| | Electricity consumption | ----- | 230V | 11.0A(50kV) | 15.0A(80kV) |
| | Maximum voltage consumption | ----- | 3.0kVA | $\pm 10\%$ | |
| | Line Voltage regulation | ----- | 4.8% | | |
| | Leakage current: Normal condition | | 1.215mA | | |
| | Single fault condition | | 2.172mA | | |

Output : Inverter : 1.6 kW · 80 kHz high frequency inverter system with
neutral ground
tube potential feedback system
tolerance $\pm 10\%$

Filament circuit : 0.2 kW · 45 kHz inverter
tube current feedback system
tolerance $\pm 10\%$
pre-heat time : approximately 2.0 sec.

X-ray Output :

Tube voltage : tolerance $\pm 10\%$
Maximum tube voltage: 80 kV
Minimum tube voltage: 50 kV
kV switch: 2 kV step

Tube current : tolerance $\pm 20\%$

20mA 0.02 to 0.1sec

16mA 0.11 to 2.0sec

Exposure timer : tolerance $\pm 10\% + 1\text{msec}$

0.02 – 0.2 sec. 0.01sec step

0.2 – 0.4 sec. 0.02sec step

0.4 – 1.0 sec. 0.05sec step

1.0 – 2.0 sec. 0.1sec step

X-ray Tube : Toshiba: D-0813
focal spot size : 0.8 mm \times 0.8 mm
target material : tungsten
target angle : 16°
anode heat storage capacity : 10kHU

Collimator : Mikasa R-200V type J08
Continuously adjustable light beam type with central ray indicator.
On time : 45 sec.
Bulb : FUJI LAMP JC12V50W
illuminance : over 100 lux at 1 m SID
Contrast ratio : over 3:1 at 1 m SID

Dual Laser Pointers (model LP4) : Laser type: Class IIIa Laser Diode
Maximum output: < 3.0 mW
Wave length: 600-680nm
Beam length: 15mm at 60cm
Power 12VDC

Filtration : inherent filtration(tube head) 2.5 mm Al
collimator filtration 0.5 mm Al
total filtration 3.0 mm Al

Size : 7.2" (18.2 cm) W \times 5.9" (15.0 cm) H \times 12.2" (31.0 cm) L
Weight : 14.3lbs (6.5 kgs)

Power Cord : 20 feet (6.1m)
Exposure Switch Cord : 8 feet (2.44 m)
Fuse : 30A @ 120V, 15A@230V

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 back of the x-ray unit to ON.

Each indicator will illuminate.



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.

kV SETTING : Set kV in the range of 50 kV to 80 kV.

TIMER SETTING : Set timer in the range of 0.02 sec. to 2.00 sec. depending on subject, distance and screen/film combination.

mA SETTING : No adjustment.

SELECTION OF sec OR mAs INDICATION:

You can choose the sec or mAs indication by the switch.

(refer page 8.)

MEMORY FOR TECHNIC FACTOR:

Five different technique settings can be stored in memory for quick recall on the unit.

To store a technique setting, press the Memory Storage button MR then press memory Recall button M1.

This will store the technique setting displayed in memory position M1. Repeat this process for storing the different technique setting in M2-M5 as desired. Stored technique settings can be easily recalled by simply pressing M1-M5.

SOURCE-IMAGE DISTANCE:

Use the tape measure on the side of the x-ray unit to confirm that the x-ray unit is positioned at the correct source-image distance (SID) for the view being taken.

ADJUSTMENT OF RADIATION FIELD :

Pressing the collimator switch will illuminate the field for approx. 45 sec.
Adjust light field to position of radiograph by two knobs for adjustment of opening. During this time, use the adjustment knobs to size the radiograph.

RADIOGRAPHY :

All safety checks, press only first stage of EXPOSURE SWITCH.
STANDBY indicator goes on after 2 sec. Then, unit is ready for exposure.
Press and hold the second stage of EXPOSURE SWITCH. X-RAY indicator illuminates, the buzzer sounds, and x-ray is generated for the time set. The EXPOSURE SWITCH is a DEADMAN style. If the button is released during exposure, exposure is stopped and error lamp will be blinking.
Press and hold the button until exposure is complete.



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.

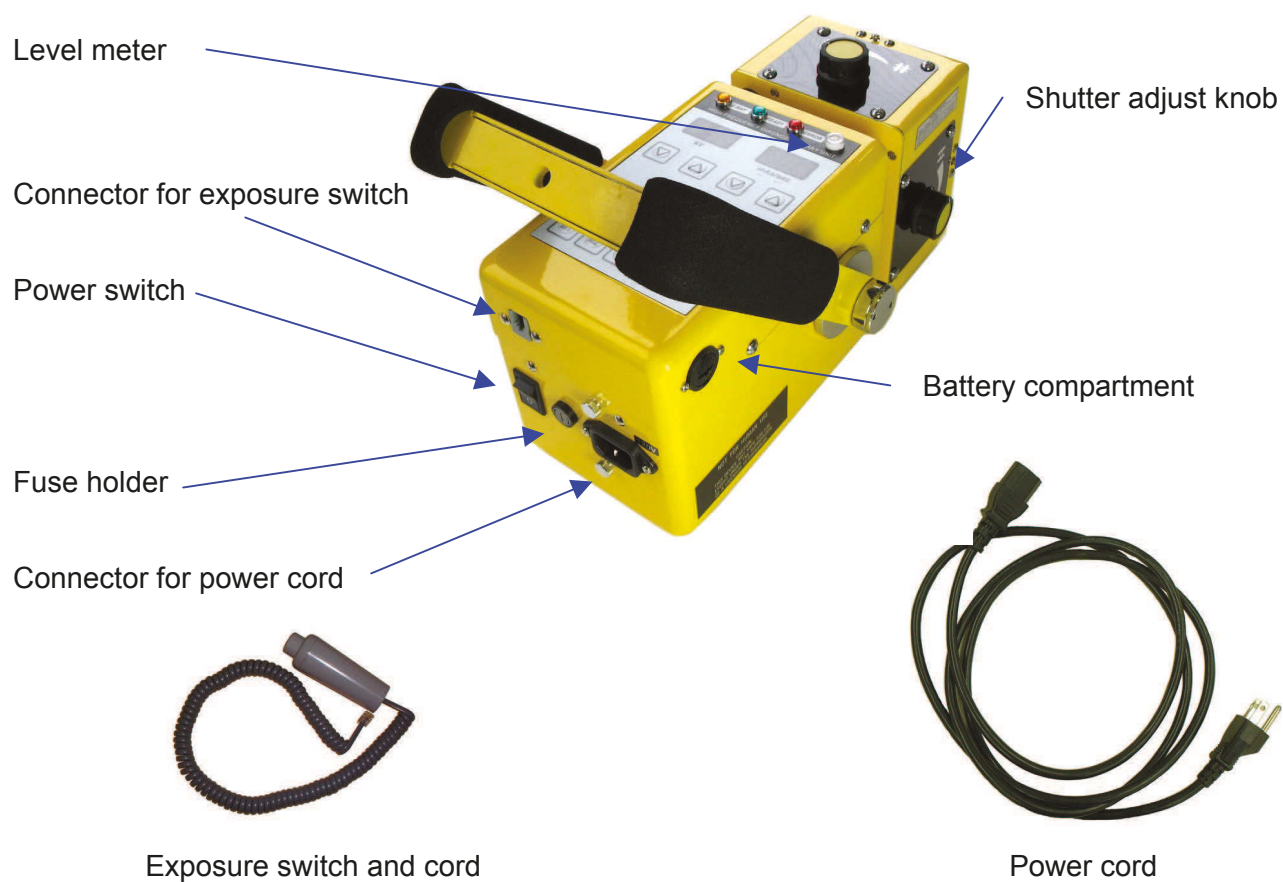
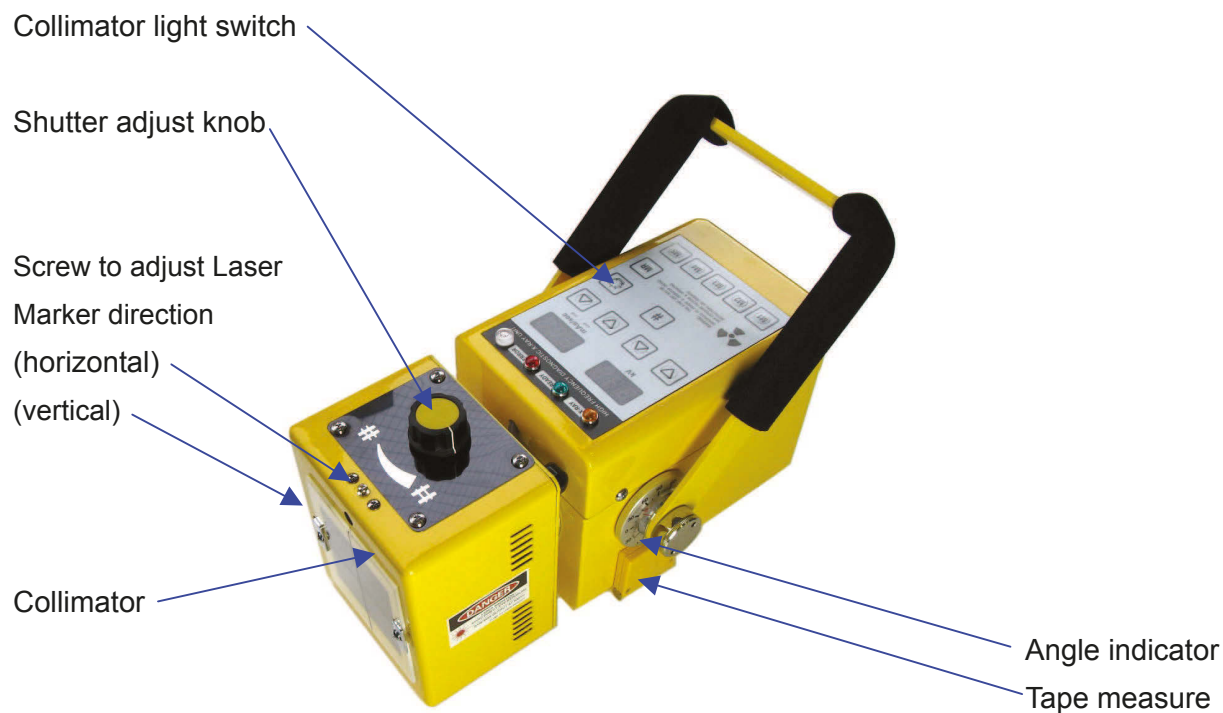
POWER OFF : When the POWER SWITCH is pressed, all indicators on the control panel are off.

ERROR LAMP : This unit has 2 kinds of error indications. If either of them is lit, x-ray cannot be generated. Each detail is as follows.

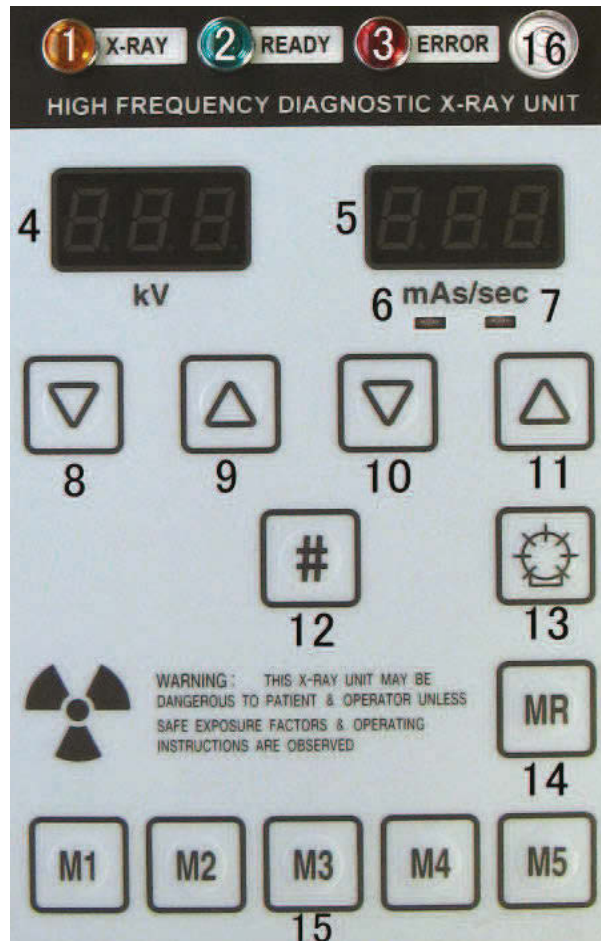
| ERROR LAMP | DETAILS | COUNTERMEASURE |
|------------|---|---|
| Blinking | Exposure switch was released during the X-ray exposure. | Turn off the unit then turn on the unit after 15sec to reset. |
| On | Unit malfunction. | Stop procedure and follow steps below. |

※ 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. If the error indicator remains lit, the parts of the unit are out of order.

5.0 Main parts



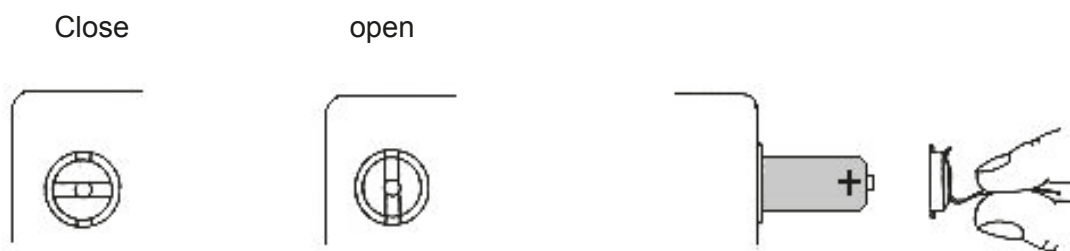
1. X-ray Indicator
2. Ready Indicator
3. Error Indicator
4. kV Indicator
5. Exposure time (sec)/ mAs Indicator
6. mAs Indicator
7. sec Indicator
8. kV Adjustment Button (-)
9. kV Adjustment Button (+)
10. sec/mAs Adjustment (+)
11. sec/mAs Adjustment (-)
12. Shift Button
13. Collimator light switch
14. Memory Storage Button
15. Memory Recall Buttons (M1 to M5)
16. Level meter



BATTERY EXCHANGE INSTRUCTIONS

Memory Storage uses two (2) size AA alkaline batteries inside the Battery Compartment, located on the backside of equipment. Open the Battery Compartment using a coin, turning the compartment lid counterclockwise 90°. If there are no batteries in the Battery Compartment, use some adhesive tape to help you remove the compartment lid.

Insert two (2) size AA alkaline batteries in the Battery Compartment, with the + end toward the Battery Compartment lid. Reattach the Battery Compartment lid and lock it with a coin, turning it clockwise 90°.



LASER ALIGNMENT INSTRUCTIONS

Before using the Dual Laser Pointers, you must adjust the position of the two laser beams to indicate the central ray of the x-ray unit at the source-to-image-distance (SID) you typically use. The adjustments can be made with a Phillips (+) screwdriver.

Set up the x-ray unit indoors at the SID you typically use, pointing to a wall or x-ray cassette. Use the tape measure attached to the x-ray unit to confirm the correct SID.

The adjustment screws for the two laser beams are on the top and side of collimator. (See photo below)

Turn on the collimator light and laser beams together by pressing the COLLIMATOR LIGHT ON BUTTON on the control panel, or the first stage of the EXPOSURE SWITCH. Make sure that the cross hair projected by the collimator lamp indicating the central ray is visible at this SID.

Use the screwdriver to turn the adjustment screw for each laser beam to calibrate its position on the wall or x-ray cassette at your typical SID. One laser projects a horizontal beam (—). The other laser projects a vertical beam (|).

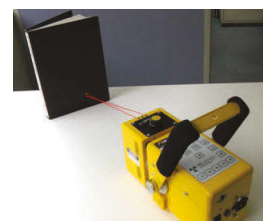
When you have finished adjusting the position of the laser beams, a laser cross (+) should be visible superimposed on the cross hairs projected by the collimator lamp.

NOTE: The Laser Pointers have been adjusted at the factory to the central ray at a SID of 27.6"(70 cm). The range of available adjustment of the Laser Pointers is 19.7" - 39.4" (50cm – 100cm) SID.



One adjustment screw adjusts the laser beam UP and DOWN. Turning this screw clockwise the laser beam DOWN. (The adjustment screw is located on the side of the collimator.)

The other adjustment screw adjusts the laser beam RIGHT and LEFT. Turning this screw clockwise adjusts the laser beam LEFT. (The adjustment screw is located on the top of the collimator.)



When you have finished adjusting the position of the laser beam, a laser cross (+) will be visible on the wall or x-ray cassette, superimposed on the cross hairs projected by the collimator lamp.

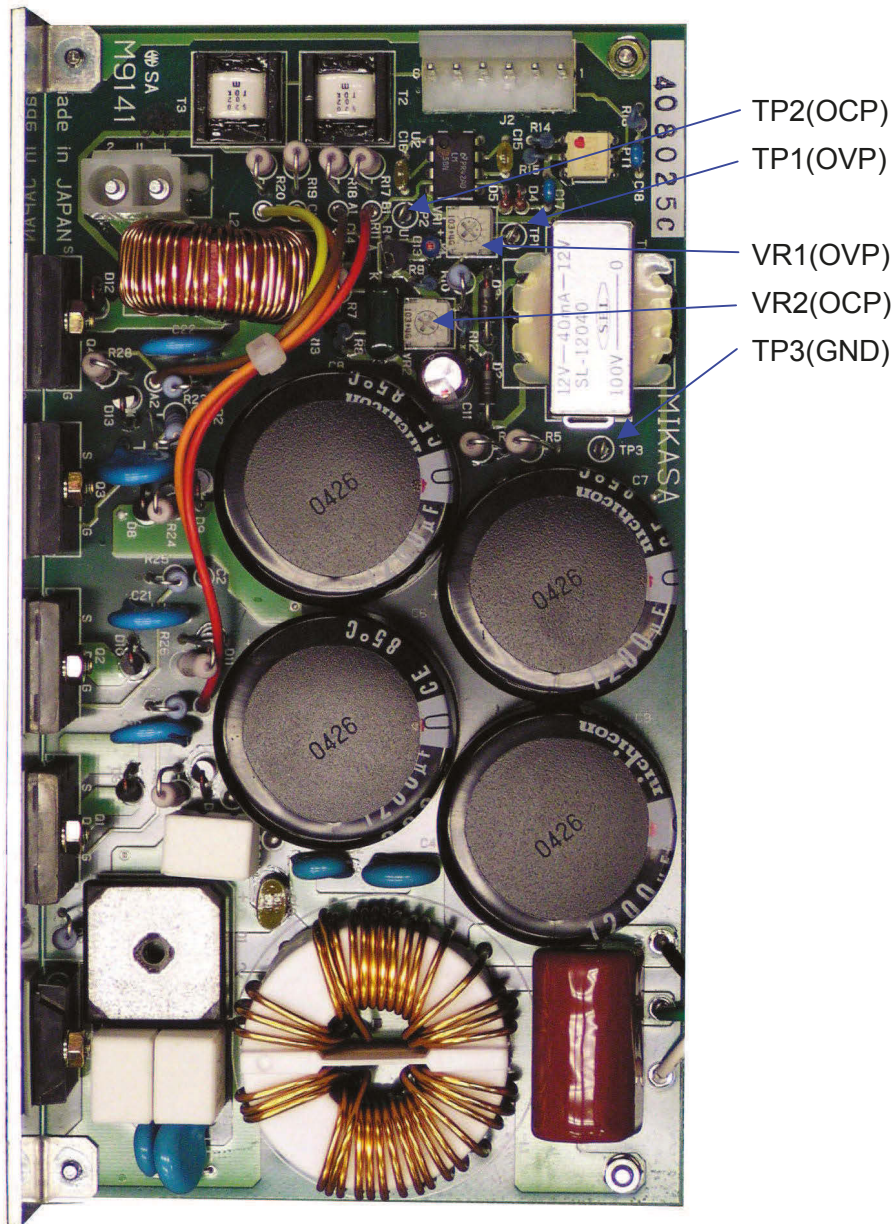


**WARNING: DO NOT LOOK DIRECTLY INTO THE COLLIMATOR
WHEN THE DUAL LASER POINTERS ARE ENERGIZED.
PERMANENT EYE DAMAGE MAY RESULT.**

6.0 Pre-Adjustment

6-1. M9141 PC Board for HF8020 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. Adjustment of VR2 (Over Current Protection circuit)

Adjust voltage between OCP(+) and GND (–) to be 1.45 – 1.55 V by turning VR2.

Turning clockwise increases voltage.

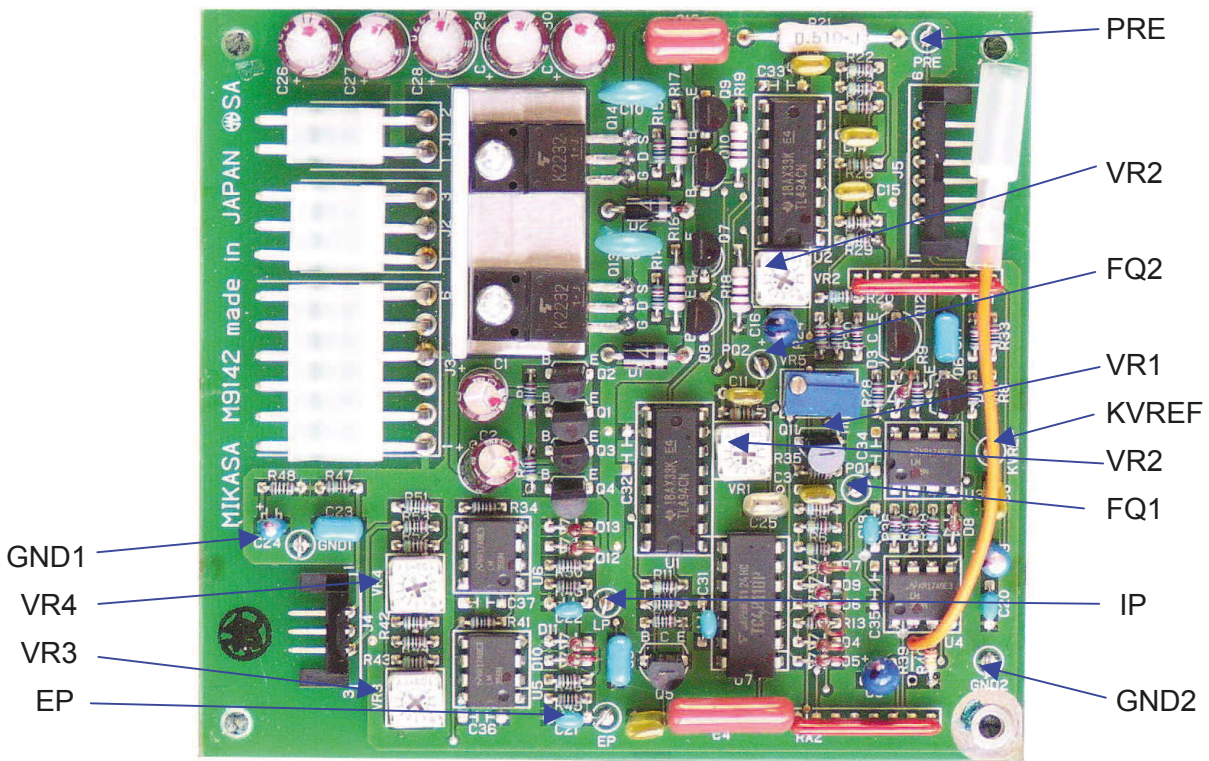
2. Adjustment of VR1 (Over Voltage Protection circuit)

Adjust voltage between OVP (+) and GND (–) to be 1.8 – 2.0 V by turning VR1.

Turning clockwise decreases voltage.

6-2. M9142 PC Board for HF8020 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. Adjustment of FQ1

Adjust frequency between FQ1 (+) and GND (–) to be 120 kHz by turning VR1.

Turning clockwise increases frequency.

2. Confirmation of FQ2

Confirm if frequency between FQ2 (+) and GND (–) is 80 kHz by turning VR2.

Turning clockwise increases frequency.

3. Confirm the VR3 (EP SET) to near the center position.

4. Confirm the VR4 (IP SET) to near the center position.

5. Adjustment of VR5

Turning clockwise increases voltage.

Adjust voltage between PRE(+) and GND (–) to be 0.43 V by turning VR5

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 (M9141 PCB) is replaced.

Oscilloscope (with storage mode) : Connect CH1 probe to EP, CH2 probe to IP, and GND to GND terminal on M9142 PC Board. (refer page 10)

Setting of oscilloscope: CH1 ; 1.0 V/div, CH2 ; 500m V/div, 20 msec/div

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

Place of adjustment : VR3 on M9142 PC Board (EP SET)

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 VR3.
After the adjustment is finished, set x-ray output to be 80kV and adjust again so that average of peak values of EP waveform to be 3.9 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 77.5 ~ 79 kV at 80 kV station.**

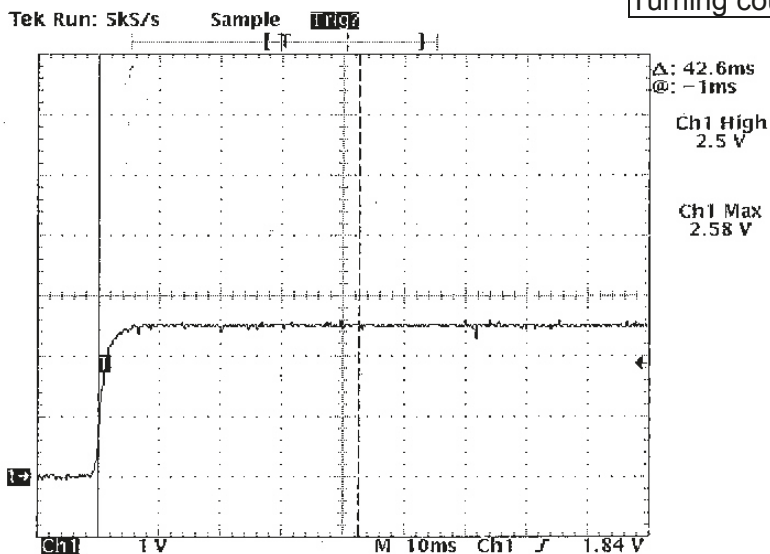


It is necessary to measure the actual kV with a direct x-ray measuring Equipment such as NERO for the confirmation after this adjustment.

7-1. Adjustment of 50 kV by VR3

Adjust the ch1 (EP) by VR3 to be $2.4 \text{ V} \pm 0.05 \text{ V}$.

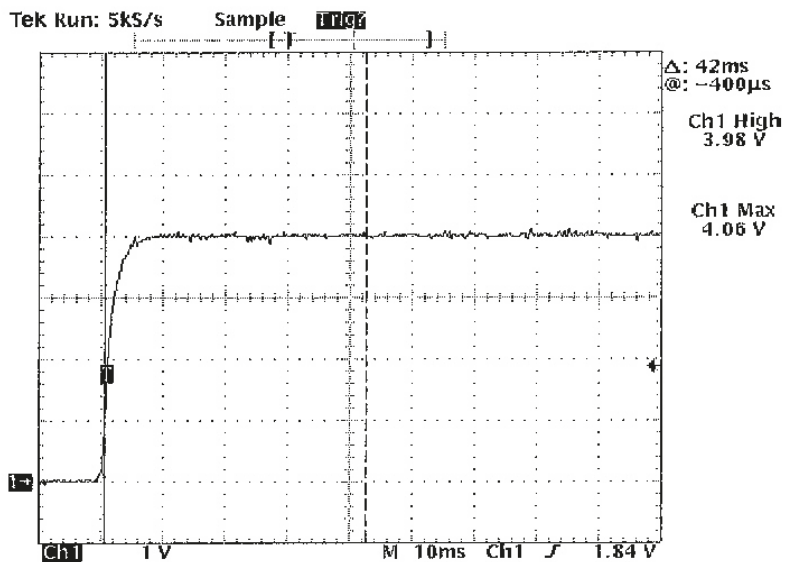
Turning counterclockwise increases kV.



7-2. Adjustment of 80 kV by VR3

Adjust the ch1 (EP) by VR3 to be $3.9 \text{ V} \pm 0.05 \text{ V}$.

Turning counterclockwise 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 (M9141 PCB) is replaced.

Oscilloscope (with storage mode) : Connect CH1 probe to EP, CH2 probe to IP, and GND to GND terminal on M9142 PC Board. (refer page 10)

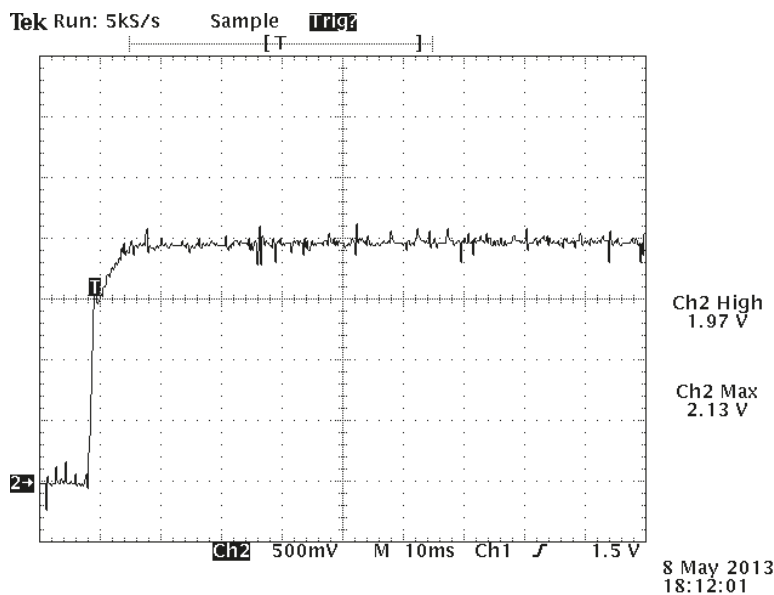
Setting of oscilloscope : CH1 ; 1.0 V/div, CH2 ; 500m V/div, 10 msec/div

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

Place of adjustment : VR4 on M9142 PC Board (IP SET)

VR4 : adjustment of mA at 70kV.
(mA is increase by turning counterclockwise.)

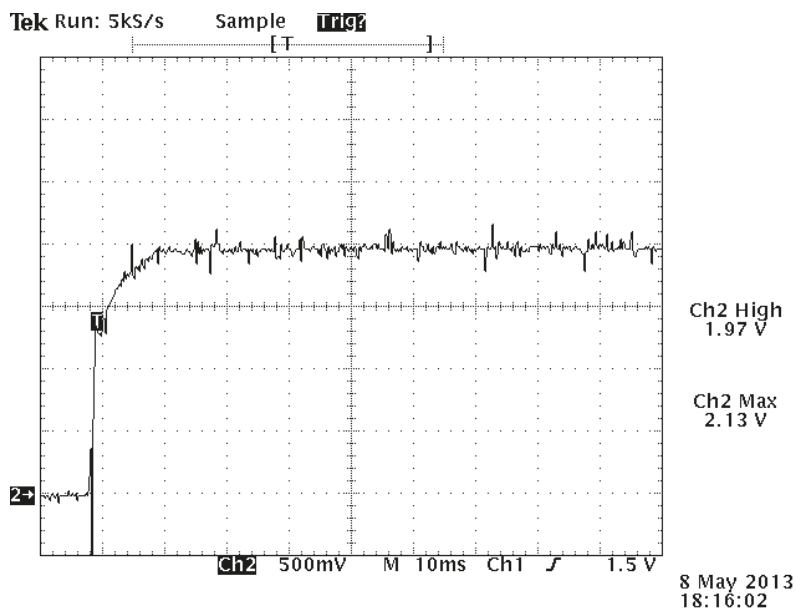
8-1.Adjust average of peak values of IP waveform to be 2.0 V by VR4.



8-2. Adjustment of 20mA at 50kV by VR4

Adjust the ch2 (IP) by VR4 to be $2.0 \text{ V} \pm 0.05 \text{ V}$.

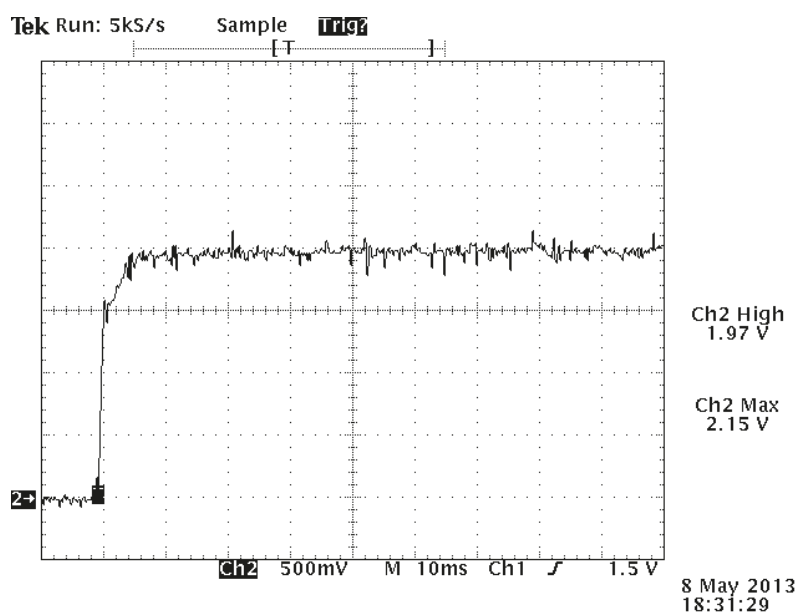
Turning counterclockwise increases mA.



8-3. Adjustment of 15mA at 80kV by VR4

Adjust the ch2 (IP) by VR4 to be $2.0 \text{ V} \pm 0.05 \text{ V}$.

Turning clockwise increases mA.



9. 0 Re-Adjustment of Pre-heat value



**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 (M9141 PCB) is replaced.

Oscilloscope (with storage mode) : Connect CH1 probe to EP, CH2 probe to IP, and GND to GND terminal on M9142 PC Board. (refer page 10)

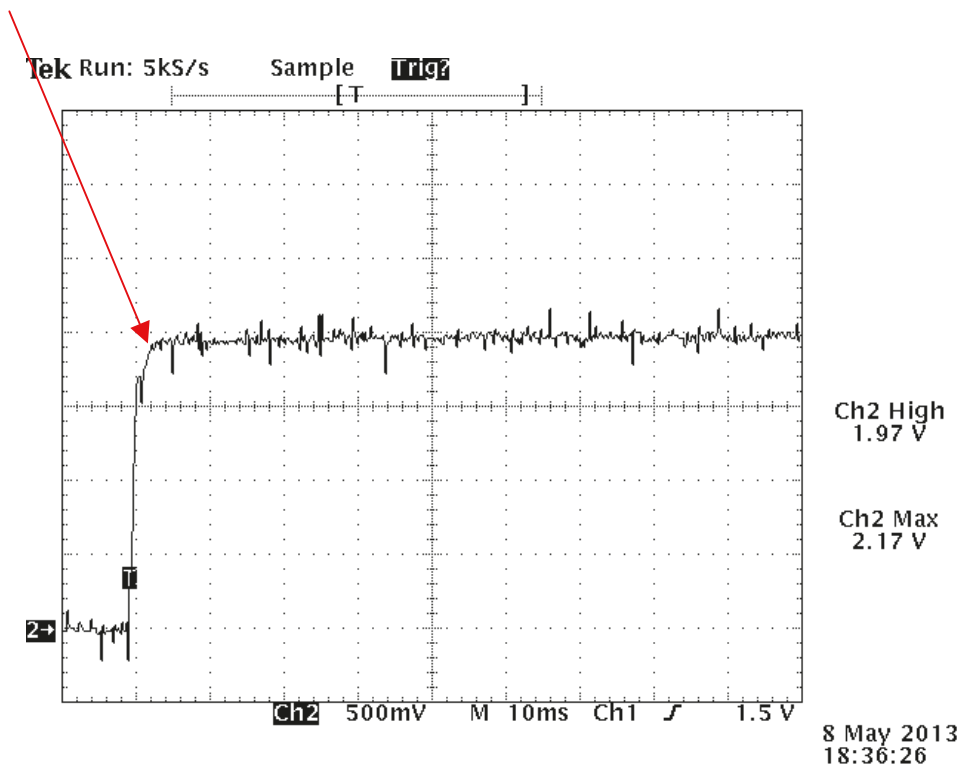
Setting of oscilloscope : CH1 ; 1.0 V/div, CH2 ; 500m V/div, 10 msec/div

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

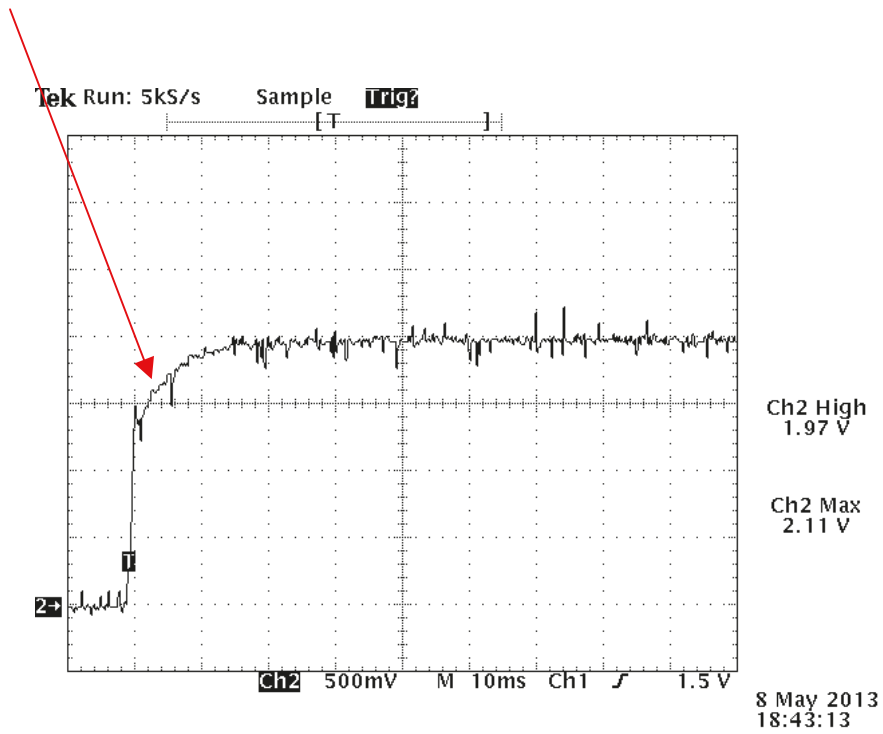
Place of adjustment : VR4 (IP SET)
VR5 (Pre-heat voltage)

9-1.Adjust peak values of IP waveform to be 2.0 V at 70kV by VR4.

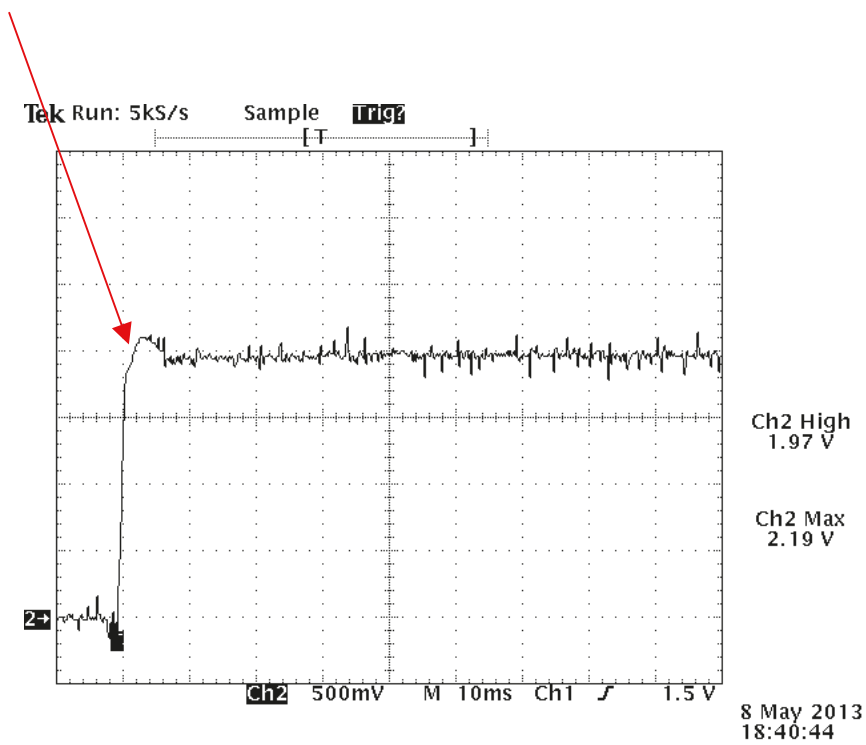
1. Pre-heat value is appropriate.



2. **Pre-heat value is low.** Make Pre-heat value increase by turning VR5 clockwise.



3. **Pre-heat value is high.** Make Pre-heat value decrease by turning VR5 clockwise.



10.0 Re-Adjustment of exposure time

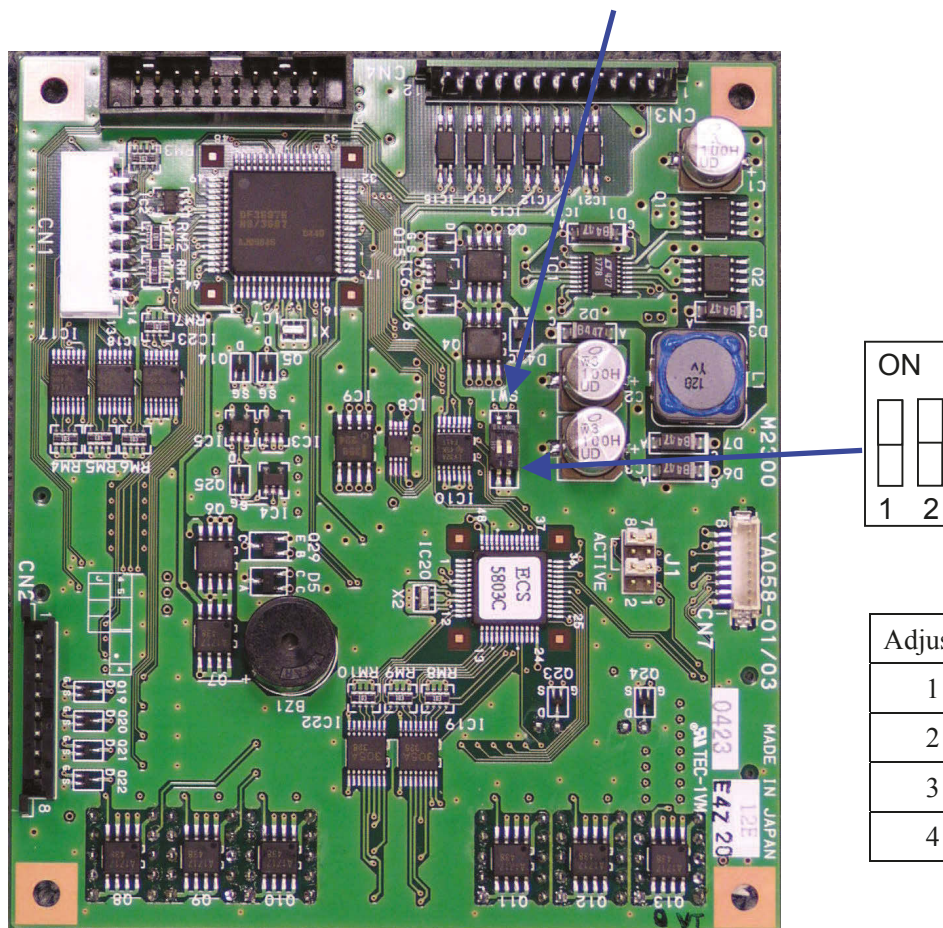


**This adjustment has to be done after connecting all connectors completely.
Actual x-ray exposure is necessary.
This adjustment requires that an exposure be made.
Please observe all radiation related safety precautions.**

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.

※Turn off a power of unit when you change a Dipswitch.

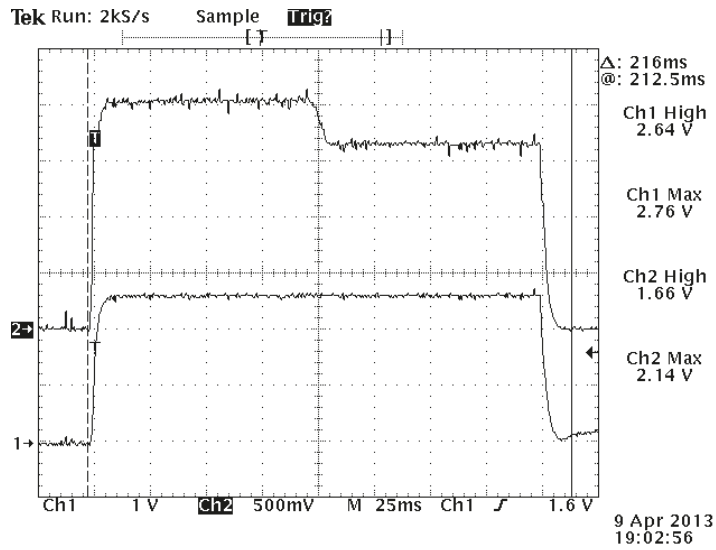


| Adjust | DIP1 | DIP2 |
|--------|------|------|
| 1 | OFF | OFF |
| 2 | OFF | ON |
| 3 | ON | OFF |
| 4 | ON | ON |

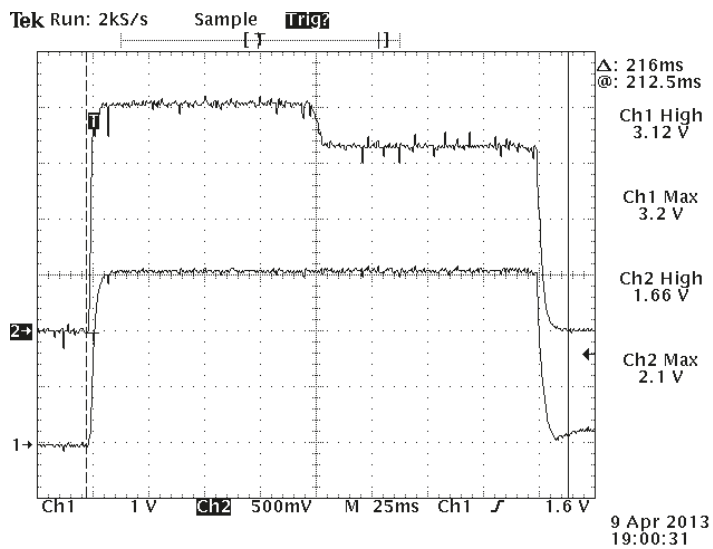
| | Adjust 1 DIP1:OFF DIP2:OFF | Adjust 2 DIP1:OFF DIP2:ON | Adjust 3 DIP1:ON DIP2:OFF | Adjust 4 DIP1:ON DIP2:ON | Filament TIME |
|-------------------|----------------------------------|---------------------------------|---------------------------------|--------------------------------|------------------|
| Ver.1 Jun.2005 | 0 | +0.008 sec | +0.0085 sec | 0 | 4 sec |
| Ver.2 Jun.2008 | +0.007 sec | +0.008 sec | +0.009 sec | +0.01sec | 4 sec |

11.0 Sample of Output waveform

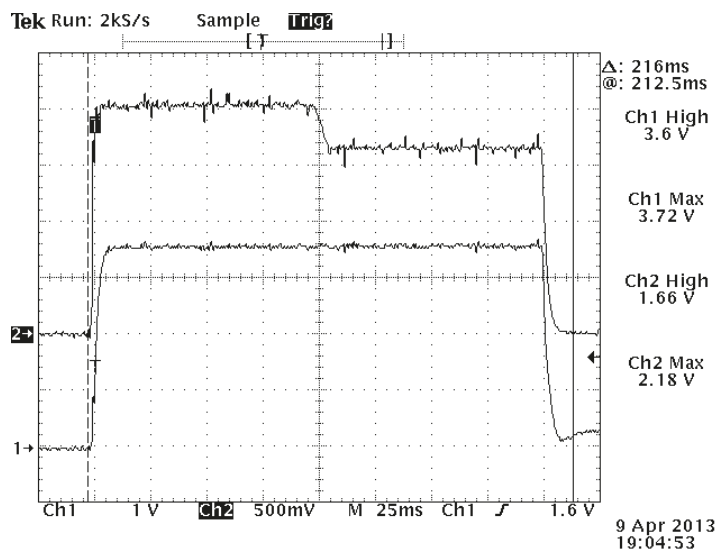
Normal waveform



50kV · 20mA

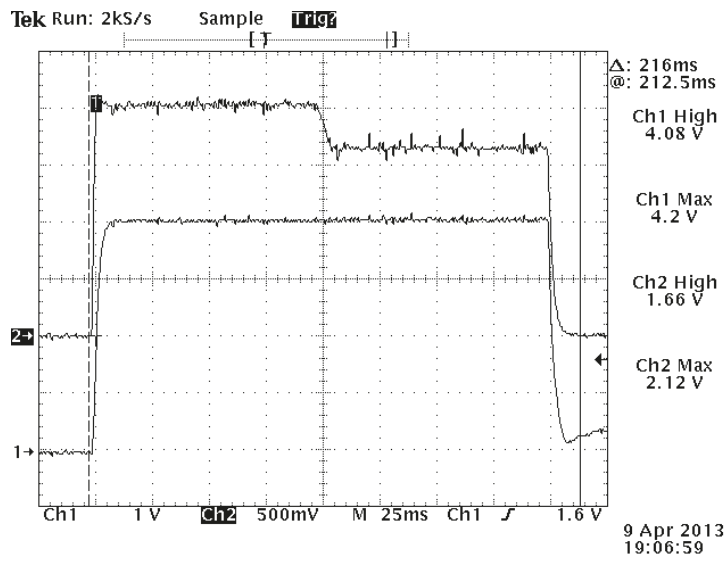


60kV · 20mA



70kV · 20mA

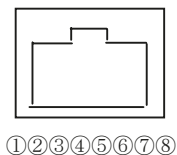
80kV · 20mA



The x-ray unit has an interface circuit for connection to a DR imaging system. When using a DR system, we recommend that you connect the interface cable to the x-ray unit using this connector.

Interface Connector Description

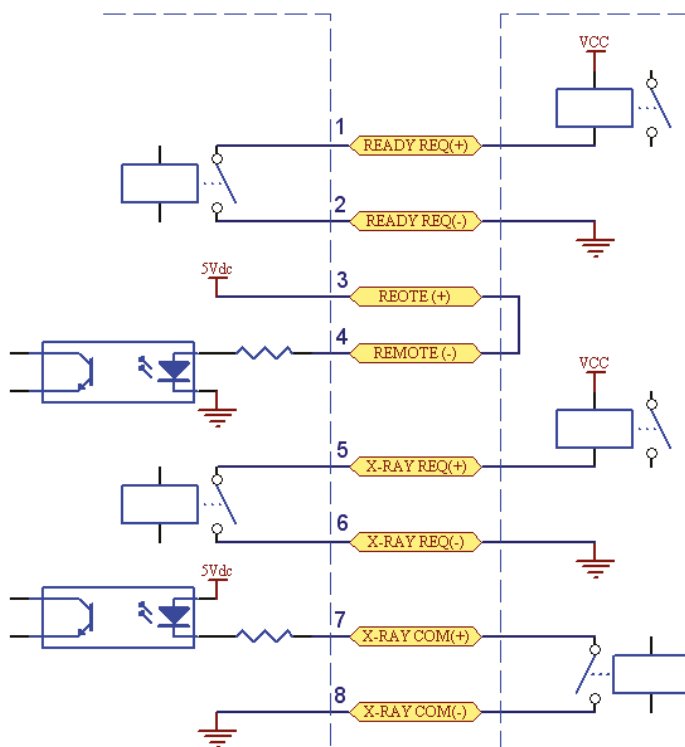
Model: RJ45



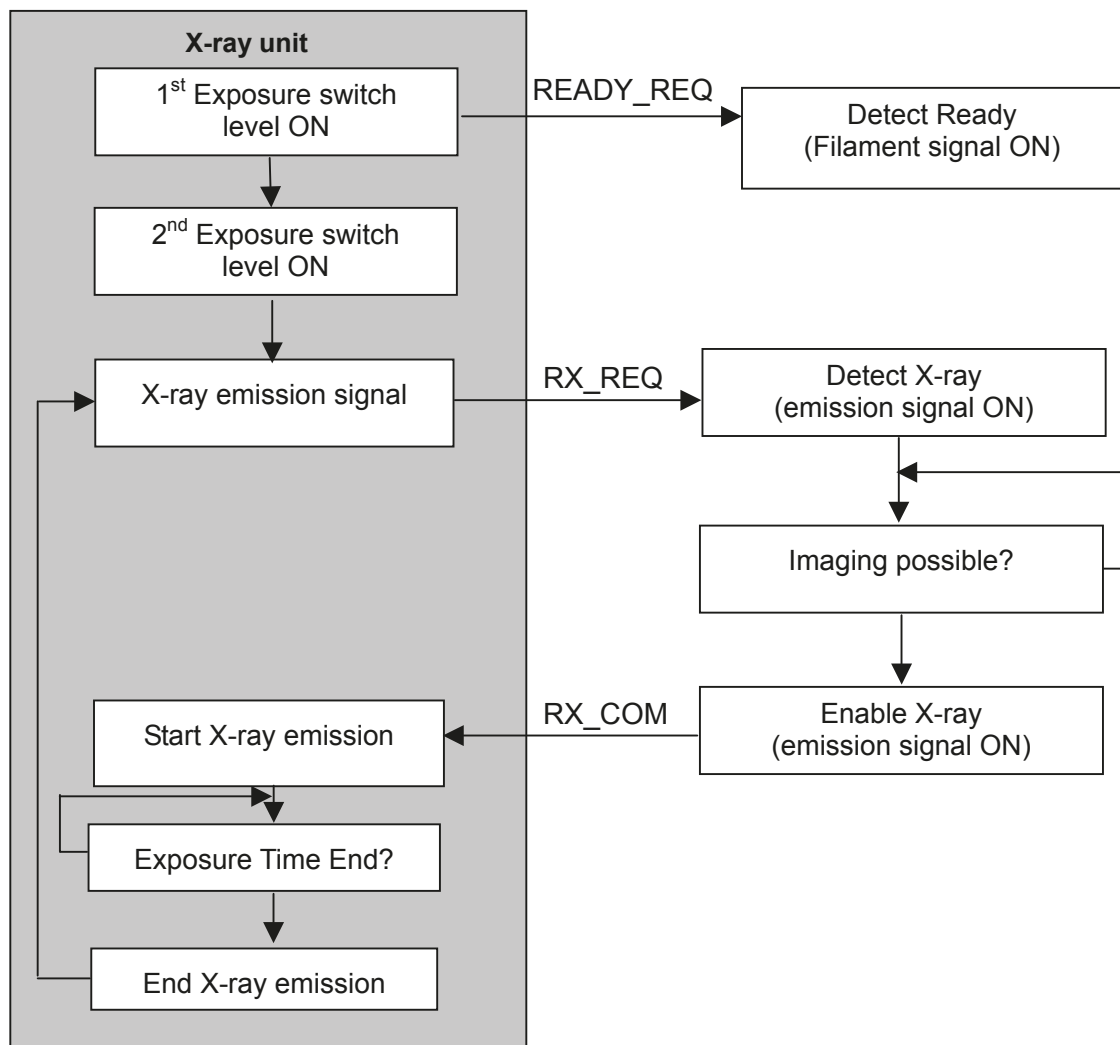
| | Signal name | IN / OUT | Functions |
|---|---------------|----------|--|
| 1 | READY_REQ_(+) | OUTPUT | Filament On signal: Indicates that a filament On signal is ordered from the x-ray unit side. |
| 2 | READY_REQ_(-) | | |
| 3 | REMORT_SW | INPUT | Remote control enable signal: |
| 4 | REMORT_SW | | |
| 5 | X-RAY_REQ_(+) | OUTPUT | X-ray ON signal: Indicates that an X-ray ON signal is ordered from the x-ray unit side. |
| 6 | X-RAY_REQ_(-) | | |
| 7 | X-RAY_COM_(+) | INPUT | X-ray expose signal: Checks whether or not imaging is ready at the DR system side after receiving X-ray ON signal (RX_REQ) from the x-ray unit. |
| 8 | X-RAY_COM_(-) | | |

X-ray unit side

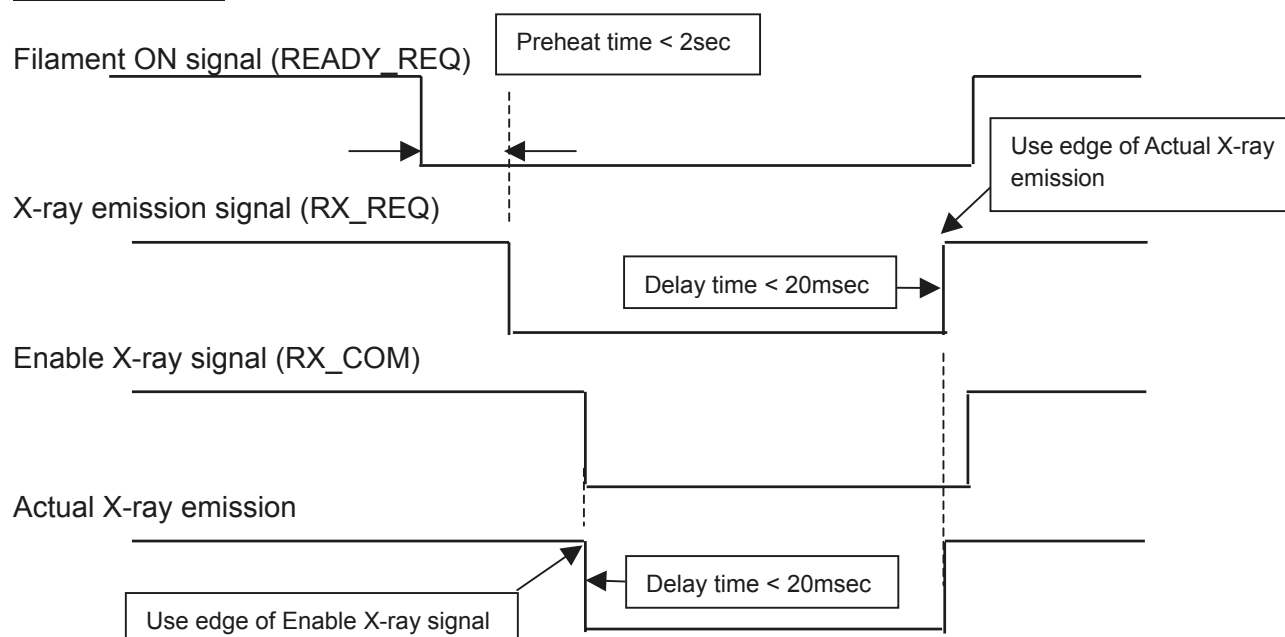
DR system side



Interface Signal Description



Signal Drawing



The outline of DR interface

DR interface before the serial number 35628 does not have the output of a READY ON signal. These units cannot take DR system and the synchronization which need a READY ON signal. Please refer to the following about the signal of each DR.

| | Filament ON signal | X-ray ON signal |
|---------|--------------------|-----------------|
| CANON | Not required | Required |
| FUJI | Required | Required |
| KONIKA | Required | Required |
| KODAK | Required | Required |
| VARIAN | Required | Required |
| SAMSUNG | Not required | Required |
| | | |